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NEW PRIMARY

ARITHMETIC

Edward Brooks, A.M.Ph.D.

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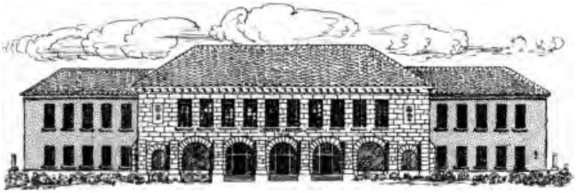

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THE

NEW NORMAL PRIMARY ARITHMETIC,

DESIGNED AS AN

INTRODUCTION

TO A

THOROUGH AND COMPLETE COURSE

IN

MENTAL AND WRITTEN ARITHMETIC.

BY EDWARD BROOKS, A. M., PH. D.,
SUPERINTENDENT OF PUBLIC SCHOOLS OF PHILADELPHIA, LATE PRINCIPAL OF PENNSYLVANIA STATE NORMAL SCHOOL, AND AUTHOR OF "THE NORMAL SERIES OF ARITHMETICS," "NORMAL ELEMENTARY ALGEBRA," "NORMAL GEOMETRY AND TRIGONOMETRY," "PHILOSOPHY OF ARITHMETIC," ETC.

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PREFACE.

THIS little work, as its title indicates, is designed to precede, and prepare the student for a thorough course in Mental and Written Arithmetic. Its peculiarities, although such as can be better appreciated by an examination of the book itself, will be briefly specified.

1. *Oral exercises* have been made a prominent feature of the plan, and many suggestions are presented indicating the manner in which such exercises should be conducted.

2. Addition and Subtraction are so arranged that they must be taught simultaneously—the process of Subtraction thus being derived as a result of Addition. This is the method adopted by some of our best educators, and is based upon sound philosophy. Multiplication and Division are treated in the same manner—Division being presented as an inverse process, and hence a result, of Multiplication.

In Multiplication, instead of requiring the pupil to commit to memory a multiplication table, without his having an idea of the origin or use of it, he is led to derive it for himself, and then learn it for the purpose of avoiding the labor of obtaining a product each time he wishes to use it. The child is taught to derive his own division table from the table of products.

3. The fact that mental and written exercises should be combined in the child's first book being so evident, the author has given a large collection of problems for state or blackboard exercises, to be used in connection with the exercises in mental arithmetic.

4. The author has omitted all representations of objects by means of *pictures*. Many reasons might be offered for this, among the most prominent of which is the fact that they are not needed, since the objects themselves are preferable to mere pictures of objects. The pupil should be so thoroughly drilled with Oral Exercises that by the time he can read a book on Arithmetic he may be able to compute without the assistance either of objects or their pictures.

5. Much care has been exercised throughout the entire work that the arrangement should be systematic, the lessons carefully graded, and the whole be in accordance with the principles of Analysis and Induction.

The entire work is the result of much thought and observation in primary instruction, and is presented to a discriminating public, with the earnest desire that it may do much for the education of the youth of our country.

EDWARD BROOKS.

State Normal School, June 16, 1878.

SUGGESTIONS TO TEACHERS.

THE following suggestions are made for the younger and less experienced teachers who may use this work:

1. It is respectfully suggested that the Oral Exercises receive that attention which their great importance demands. The pupils should be constantly drilled on exercises besides those found in the book. With young pupils, all numerical ideas should be developed with objects; lessons with the numeral frame will also be found of great value.

2. The problems in Mental Arithmetic should be assigned promiscuously, pupils not being allowed to use the book during recitation. The pupil selected should arise, repeat the problem, and then give the solution; at the close of which those who have observed mistakes may indicate it by raising the hand, and then some one indicated by the teacher may give the criticism. Sometimes the entire class may be required to merely write the result on paper or the slate.

3. The exercises in Written Arithmetic should be solved upon paper or the slate as a preparation for the recitation, and upon the blackboard, slate, or paper during the recitation. The same problem may be given to the whole class, or each member may receive a different problem, as the teacher prefers; with beginners the first method is thought to be preferable. At first perhaps it is better to teach them the mechanical operations, showing them the reasons for these operations, but not requiring them to state these reasons in recitation until they have acquired considerable readiness in the different processes. This last suggestion is founded upon the natural order of the unfolding of the young mind, and also upon the experience of some of the most successful teachers of youth.

4. The elementary *sums* and *products* should at first be derived with objects: and after pupils understand them and know how to derive them, special pains should be taken to have them committed to memory. The elementary differances are to be derived from the elementary sums and the elementary quotients from the elementary products.

5. Teachers who desire to do so can combine corresponding lessons in addition and subtraction, as adding and subtracting by 2s, adding and subtracting by 3s, etc. Similar combinations may also be made in multiplication and division; and the products and quotients with the smaller numbers may be learned before all the elementary sums and differences are completed.

6. Care should be taken that the pupils' language be free from all those awkward expressions so common to learners; each sound should be enunciated distinctly, each word correctly pronounced, and the habit of ready and accurate thought be developed—thus securing that combination so admirable in scholarship,—promptness, accuracy, and elegance.

NEW

PRIMARY ARITHMETIC.

SECTION I.

NUMERATION AND NOTATION.

INTRODUCTION.

Suggestions to the Teacher.

OUR first ideas of numbers are derived from visible objects, hence the child's first lessons in numbers should be given with such objects. These objects may be books, pencils, grains of corn, beans, etc. Dr. Hill suggests that arithmetic may be taught with a pint of beans. The *arithmetical frame* is the most convenient for general use.

NAMING NUMBERS.—The names of numbers are usually acquired with the ideas of numbers; and both are given by a process called *counting*. Children should therefore be taught *to count*. Be careful that they do not use the names as mere words; see that they know what the words mean. Children can often count as far as a hundred, and yet are unable to select twelve objects from a collection. Have the pupils count with the *numeral frame* and with other objects.

Beside the common method of counting, I would teach pupils to count, using the expressions *one and ten, two and ten, three and ten*, etc., *two tens and one, two tens and two*, etc. It will teach them the principle of naming numbers, and prepare them to understand the method of writing numbers.

A counting exercise may be made lively by increasing or diminishing the number by several at the same time. Little *counting games*, with beans or grains of corn, will also be found interesting to children. Have children count *backward* as well as *forward*.

WRITING NUMBERS.—As soon as a child can name numbers, it should be taught to write them. It might be well at first to write the words *one, two*, etc., and then introduce the figures, that pupils may see their advantage in brevity.

Characters.—First give the *nine digits*, and drill children in naming and writing them until they are entirely familiar with these characters. If they have learned a little addition and subtraction, they may use the characters in solving simple problems.

Combination.—When the pupils are familiar with these characters, they should be taught to combine them. There are two distinct methods of doing this.

1ST METHOD. By this method we give the combined characters without explaining the principle of the combination. Thus we teach that 10 represents *ten*, 11, *eleven*, 12, *twelve*, etc., without any reference to tens and units. This method is not quite so philosophical as the 2d method, but is preferred by many teachers with young learners.

We would give these expressions as far as *twenty*, and then drill the pupils in reading and writing them until they are quite familiar with them. We would next give the expressions from *twenty* to *thirty*, and drill in like manner, and thus continue as far as *one hundred.*

After the pupils are familiar with this method of writing numbers as far as 100, the teacher may then show them the principle of the combination, that the figure in the first place represents *units*, in the second place *tens*, etc. When this is understood we would require the class to analyze these expressions as follows:

PROB. Analyze 25 (*twenty-five*).

ANALYSIS. In 25, the 5 represents 5 *units*, and the 2 represents 2 *tens*.

2D METHOD. The other method begins by explaining the principle of the combination, that is, that 10 represents 1 *ten;* 11, 1 *ten* and 1 *unit;* 12, 1 *ten* and 2 *units*, etc., afterwards showing that 11 (1 *ten* and 1 *unit*) is the same as *eleven*, etc.

This may be done by making *ten* marks on the board, and then commencing a second row with *one* mark; and showing them that as the *one* is expressed by 1, the *one ten* may be expressed by writing a 1 at the left of the first 1, and that 11 represents *one and ten;* that *two and ten* may be expressed by 12, etc. The 0 may then be introduced, as necessary to show that the 1 is in the second place, when there is only *one ten.*

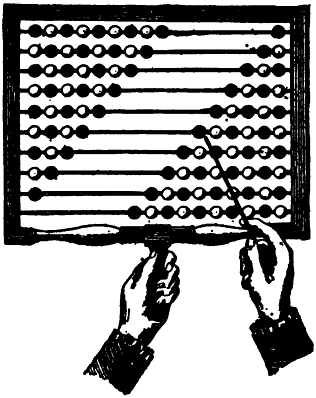
The pupil should be drilled in reading and writing numbers until he is entirely familiar with the subject. Haste here is "bad speed." A thorough knowledge of Notation and Numeration will dispel the usual difficulties of Addition, Subtraction, Multiplication, and Division.

NOTE.—We have suggested that the teacher give this instruction rather than attempted to present it on the printed page. It is simple and easily done; and the teacher, with the numeral frame in the hand, can give a life to it that it cannot possess when put in formal questions in the book. Remember that *all good teaching requires a* TEACHER.

LESSON I.

Naming and Writing Numbers.

LOOK at this picture of a *Numeral Frame* with little balls on wires. Count and tell me how many wires.



2. How many balls at the right on the upper wire? *One.*

3. How many balls at the right on the second wire? *Two.*

4. How many balls at the right on the third wire? *Three.*

5. How many balls at the right on the fourth wire? *Four.*

6. How many balls at the right on the fifth wire? *Five.*

7. How many balls at the right on the sixth wire? *Six.* On the seventh wire? *Seven.*

8. How many balls at the right on the eighth wire? *Eight.* On the ninth wire? *Nine.* On the tenth wire? *Ten.*

9. How many hands have you? How many thumbs have you?

10. How many fingers on one hand? How many fingers on both hands?

11. How many chairs in this room? How many windows in this room?

12. We will now show you how to write numbers from *one* to *ten.*

One,	*Two,*	*Three,*	*Four,*	*Five,*	*Six,*	*Seven,*	*Eight,*	*Nine,*	*Ten.*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*

13. You will write one, two, three, four, five, six, seven, eight, nine, ten. Write five, seven, six, nine, etc.

LESSON II.

Naming and Writing Numbers.

COUNT from ten to twenty. *Ans.* Eleven, twelve, thirteen, fourteen, fifteen, sixteen, etc., twenty.

2. We will now show you how to write numbers from ten to twenty.

Eleven,	*Twelve,*	*Thirteen,*	*Fourteen,*	*Fifteen,*	*etc.,*	*Twenty.*
11	*12*	*13*	*14*	*15*	*etc.*	*20*

3. Write eleven, thirteen, twelve, fifteen, fourteen, seventeen, eighteen, sixteen, nineteen, twenty.

4. What number is expressed by 12? by 15? by 13? by 11? by 17? by 19? by 18? by 14? by 16? by 20?

5. Count from twenty to thirty. *Ans.* Twenty-one, twenty-two, twenty-three, twenty-four, etc.

6. We will now show you how to write the numbers from twenty to thirty.

Twenty-one,	*Twenty-two,*	*Twenty-three,*	*etc.,*	*Thirty.*
21	*22*	*23*	*etc.*	*30*

7. Write twenty-two, twenty-seven, twenty-four, twenty-one, twenty-five, twenty-nine, twenty-six, etc.

8. We will now show you how to write the numbers from thirty to one hundred.

Printed.	Written.	Spoken.	Printed.	Written.	Spoken.
31	*31*	Thirty-one.	65	*65*	Sixty-five.
32	*32*	Thirty-two.	70	*70*	Seventy.
40	*40*	Forty.	71	*71*	Seventy-one.
41	*41*	Forty-one.	72	*72*	Seventy-two.
45	*45*	Forty-five.	80	*80*	Eighty.
50	*50*	Fifty.	83	*83*	Eighty-three.
52	*52*	Fifty-two.	84	*84*	Eighty-four.
56	*56*	Fifty-six.	90	*90*	Ninety.
60	*60*	Sixty.	94	*94*	Ninety-four.
63	*63*	Sixty-three.	100	*100*	One hundred.

9. Write thirty-three, thirty-eight, forty-two, forty-seven, fifty-four, fifty-five, sixty-six, sixty-nine, seventy-five, seventy-seven, eighty-one, eighty-eight, ninety-nine.

SECTION II.

ADDITION AND SUBTRACTION.

INTRODUCTION.

Suggestions to the Teacher.

AFTER the pupils have the *ideas* and the *names* of numbers, they should be taught to *unite* and *separate* them; that is, *addition* and *subtraction.* Instruction in these processes should be given in accordance with the following principles:

1. *The first lessons in addition and subtraction should be given with visible objects.* This principle is founded upon the law of mental development, and will be indorsed by all thoughtful teachers. So necessary is it that if the teacher neglects it, the pupil will adopt it himself, by adding with his fingers, with strokes, etc.

2. *Addition and subtraction should be taught together in primary oral instruction.* This is evident, since the two ideas are logically related. Thus, as soon as the pupil learns that 2 and 3 are 5, he sees that 5 diminished by 2 equals 3, or 5 diminished by 3 is 2. Convenience also suggests the same method. In the primary schools of Germany, the two processes are combined in the manner illustrated.

EXERCISE.—The pupils should first *increase* and *diminish* by *one*, as far as 12, then by *two*, then by *three*, etc. The exercise would be somewhat as follows:

Teacher takes one book in his hand, and asks, "How many books have I in my hand?" Pupils answer, "One book." Teacher, taking another book in his hand, asks, "How many books have I now?" PUPILS: "Two books." TEACHER: "How many, then, are one book and one book?" PUPILS: "Two books." TEACHER: "How many books have I in my hand now?" PUPILS: "Two books." "TEACHER: "I will take one book away; now how many books remain?" PUPILS: "One book." TEACHER: "One book taken from two books, then, leaves how many books? PUPILS: "One book."

Let the teacher now take the *arithmetical frame,* and proceed in the same way, increasing 2, 3, 4, etc., up to 12 by *one*, and diminishing 3, 4, 5, 6, etc., up to 13 by *one*, each time reversing the addition. Then take *one* and increase it by *two*, obtaining *three;* then reverse the process and diminish *three* by *two*, and so on, until 12 is increased by *two*, and 14 diminished by *two*. Proceed in the same way with 3, 4, etc., until the pupil can *add* and *subtract* by *ones*, *twos*, *threes*, etc., up to *twelves*. The lessons of the book are developed on this plan, but the teacher should use the frame in connection with these lessons.

LESSON I.

Adding and Subtracting by Ones.

HENRY had 1 apple, and his father gave him 1 apple; how many apples had he then?

SOLUTION.—Henry then had 1 apple and 1 apple, which are 2 apples.

2. Mary had 2 pins, and her sister gave her 1 pin; how many pins had she then?

3. If a boy buys 3 marbles, and his brother gives him 1 marble, how many marbles has he then?

4. A girl bought 5 roses, and her sister gave her 1 rose; how many roses had she then?

5. How many are 3 and 1? 5 and 1? 7 and 1? 4 and 1? 2 and 1? 8 and 1? 9 and 1? 10 and 1?

6. Mary had 3 books and gave Sarah 1 book; how many books had Mary remaining?

SOLUTION.—Mary had remaining 3 books less 1 book, which is 2 books.

7. Thomas had 4 cents and gave 1 cent for a top; how many cents had he left?

8. A man had 10 cents and gave 1 cent to his little daughter; how many cents had he left?

9. Kate had 7 roses and gave 1 of them to Ella; how many had she left?

10. There were 11 birds on a tree, and 1 bird flew away; how many birds remained?

11. How many are 2 less 1? 3 less 1? 4 less 1? 5 less 1? 6 less 1? 7 less 1? 8 less 1? 9 less 1? 10 less 1?

WRITTEN EXERCISES.

Add	1	1	1	1	1	1	1	1	1	1	1	1
	3	4	2	5	1	8	7	9	6	10	11	12

From	3	4	2	5	1	8	7	4	6	10	12	11
Take	1	1	1	1	1	1	1	1	1	1	1	1

Ten,	*Fifteen,*	*Twenty,*	*Twenty-five,*	*Thirty.*
10	*15*	*20*	*25*	*30*

NOTE.—Drill in reading and writing numbers from 10 to 50.

LESSON II.

Adding by Twos.

HOW many cents are 2 cents and 2 cents?

SOLUTION.—2 cents and 2 cents are 4 cents.

2. How many are 1 and 2? 2 and 2? 3 and 2? 4 and 2? 5 and 2? 6 and 2?

3. How many are 7 and 2? 8 and 2? 9 and 2? 10 and 2? 11 and 2? 12 and 2?

NOTE.—We will now arrange the results we have obtained in a little table which the pupil will commit to memory.

ADDITION TABLE.

1 and 2 are 3
2 and 2 are 4
3 and 2 are 5
4 and 2 are 6
5 and 2 are 7
6 and 2 are 8
7 and 2 are 9
8 and 2 are 10
9 and 2 are 11
10 and 2 are 12
11 and 2 are 13
12 and 2 are 14

4. Ella had 3 pins and found 2 pins; how many pins did Ella then have?

SOLUTION.—Ella then had 3 pins and 2 pins, which are 5 pins.

5. I saw 5 robins in the garden and 2 robins on the fence; how many robins did I see?

6. Mary has 4 old birds and 2 little young birds; how many birds has Mary?

7. Begin at 2 and count by 2's to 14. Begin at 1 and count by 2's to 13.

NOTE.—Teach the children the use of + and =, and have them write the addition table on the board, using these symbols.

WRITTEN EXERCISES.

Add	2 3	2 5	2 7	2 6	2 9	2 4	2 10	2 8	2 11	2 12
Add	21 5	12 6	20 7	12 8	10 5	20 6	12 16	12 15	11 18	
Add	12 14	11 15	12 7	22 5	20 6	22 7	20 8	20 9	20 10	

NOTE.—Drill in reading and writing numbers from 10 to 30.

LESSON III.

Subtracting by Twos.

TWO cents taken from 5 cents leave how many cents?

SOLUTION.—Two cents taken from 5 cents leave 3 cents.

2. How many are 2 taken from 3? 2 from 4? 2 from 6? 2 from 8? 2 from 10?

3. How many are 2 taken from 5? 2 from 7? 2 from 9? 2 from 11? 2 from 12?

SUBTRACTION TABLE.

2 from 3 leaves 1
2 from 4 leaves 2
2 from 5 leaves 3
2 from 6 leaves 4
2 from 7 leaves 5
2 from 8 leaves 6
2 from 9 leaves 7
2 from 10 leaves 8
2 from 11 leaves 9
2 from 12 leaves 10
2 from 13 leaves 11
2 from 14 leaves 12

4. Mary had 5 oranges and gave 2 of them to Fanny; how many oranges had Mary left?

SOLUTION.—Mary had left the difference between 5 oranges and 2 oranges, which is 3 oranges.

5. Willie had 6 marbles and lost 2 of them; how many marbles did Willie then have?

6. Eddie tried to spell 10 words and missed 2 of them; how many did he spell correctly?

7. Begin at 14 and count backward by 2's to *two*. Begin at 13 and count backward by 2's to *one*.

NOTE.—Teach the pupils the use of — and =, and have them write the subtraction table on the board, using these signs.

WRITTEN EXERCISES.

From	4	6	5	7	3	8	2	9	10	11	12
Take	2	2	2	2	2	2	2	2	2	2	2

From	27	36	35	44	47	35	43	46	42
Take	5	4	21	21	20	22	20	23	12

Thirty,	***Thirty-five,***	***Forty,***	***Forty-five,***	***Fifty.***
30	*35*	*40*	*45*	*50*

NOTE.—The teacher will drill pupils in reading and writing numbers from 10 to 50.

LESSON IV.

Adding by Threes.

HOW many are 2 cents and 3 cents?

SOLUTION.—2 cents and 3 cents are 5 cents.

NOTE.—Use the numeral frame for these problems, if it is needed.

2. How many are 1 and 3? 3 and 3? 5 and 3? 2 and 3? 4 and 3? 6 and 3?

3. How many are 7 and 3? 9 and 3? 11 and 3? 8 and 3? 10 and 3? 12 and 3?

ADDITION TABLE.

1 and 3 are 4
2 and 3 are 5
3 and 3 are 6
4 and 3 are 7
5 and 3 are 8
6 and 3 are 9

7 and 3 are 10
8 and 3 are 11
9 and 3 are 12
10 and 3 are 13
11 and 3 are 14
12 and 3 are 15

4. There are 5 roses on one bush, and 3 roses on another bush; how many roses on both bushes?

5. I gave 4 cents to John and 3 cents to James; how many cents did I give to both?

6. Edwin had 6 tame rabbits and caught 3 wild ones; how many did he then have?

7. Begin at 1 and count by 3's to 13; at 2 and count by 3's to 14; at 3 and count by 3's to 15.

WRITTEN EXERCISES.

Add	3	3	3	3	3	3	3	3	3	3	3
	2	4	6	3	1	8	10	9	11	12	13

Add	13	23	33	40	23	31	32	23	30
	4	5	12	10	26	18	15	26	17

	2	2	0	1	1	3	2	23	13
Add	1	3	3	0	3	1	0	11	10
	6	5	6	8	7	4	9	12	24

NOTE.—Continue the drill in reading and writing numbers from 10 to 50.

LESSON V.

Subtracting by Threes.

If Emma has 5 bunches of grapes and eats 3 of them, how many bunches will remain?

Solution.—There will remain the difference between 5 bunches and 3 bunches, which is 2 bunches.

2. Three from 4 leaves how many? 3 from 6? 3 from 8? 3 from 5? 3 from 7? 3 from 9?

3. Three from 10 leaves how many? 3 from 12? 3 from 14? 3 from 13? 3 from 11? 3 from 15?

SUBTRACTION TABLE.

3 from 4 leaves 1
3 from 5 leaves 2
3 from 6 leaves 3
3 from 7 leaves 4
3 from 8 leaves 5
3 from 9 leaves 6
3 from 10 leaves 7
3 from 11 leaves 8
3 from 12 leaves 9
3 from 13 leaves 10
3 from 14 leaves 11
3 from 15 leaves 12

4. Mary had 6 cakes and gave her brother 3 cakes; how many cakes had Mary left?

5. Thomas had 8 marbles and lost 3 of them; how many marbles remained?

6. There were 9 birds on a tree and 3 flew away; how many birds remained?

7. Subtract by 3's from 15 to naught; from 14 to 2; from 13 to 1.

8. Write the subtraction table for threes on the slate or blackboard, using the signs — and =.

WRITTEN EXERCISES.

From	5	7	9	6	4	3	10	12	11	13	14	15
Take	3	3	8	3	3	3	2	3	3	3	3	3

From	24	25	27	36	40	50	58	67	54
Take	13	12	13	23	30	30	23	31	32
From	36	74	69	78	87	73	74	85	90
Take	30	23	32	33	32	31	20	30	50

Fifty,	***Sixty,***	***Seventy,***	***Eighty,***	***Ninety,***	***One Hundred.***
50	*60*	*70*	*80*	*90*	*100*

Note.—Drill in reading numbers from 50 to 100.

LESSON VI.

Adding by Fours.

HOW many boys are 3 boys and 4 boys?

SOLUTION.—Three boys and 4 boys are 7 boys.

2. How many are 1 and 4? 3 and 4? 6 and 4? 2 and 4? 5 and 4? 4 and 4?

3. How many are 7 and 4? 10 and 4? 8 and 4? 11 and 4? 9 and 4? 12 and 4?

ADDITION TABLE.

1 and 4 are 5	7 and 4 are 11
2 and 4 are 6	8 and 4 are 12
3 and 4 are 7	9 and 4 are 13
4 and 4 are 8	10 and 4 are 14
5 and 4 are 9	11 and 4 are 15
6 and 4 are 10	12 and 4 are 16

4 If there are 3 boys on one bench and 4 boys on another bench, how many boys are there on both benches?

5. A man paid 5 dollars for a pig, and 4 dollars for a lamb; how much did he pay for both?

6. I gave 8 cents to a poor woman, and 4 cents to her little daughter; how much did I give both?

7. Write the addition table for fours on the blackboard or slate, using the signs + and =.

8. Add by 4's from 4 to 16; from 1 to 13; from 2 to 14; from 3 to 15.

WRITTEN EXERCISES.

Add	4	4	4	4	4	4	4	4	4	4	4
	2	4	6	3	5	7	1	9	8	10	12

Add	43	41	14	22	33	43	42	44	34
	45	36	72	66	54	56	37	35	55

	3	2	4	4	14	23	13	34	41
Add	1	3	5	8	23	32	42	20	16
	5	4	7	6	12	14	25	15	30

NOTE.—Continue the drill in reading numbers from 50 to 100.

LESSON VII.

Subtracting by Fours.

IF we take 4 books from a pile of 7 books, how many books are left?

Solution.—There are left the difference between 7 books and 4 books, which is 3 books.

2. Four from 6 leaves how many? 4 from 5? 4 from 8? 4 from 7? 4 from 9? 4 from 12?

3. Four from 13 leaves how many? 4 from 15? 4 from 10? 4 from 11? 4 from 16? 4 from 14?

SUBTRACTION TABLE.

4 from 5 leaves 1
4 from 6 leaves 2
4 from 7 leaves 3
4 from 8 leaves 4
4 from 9 leaves 5
4 from 10 leaves 6
4 from 11 leaves 7
4 from 12 leaves 8
4 from 13 leaves 9
4 from 14 leaves 10
4 from 15 leaves 11
4 from 16 leaves 12

4. Mary had 6 roses, and gave her mother 4 roses; how many roses did Mary keep?

5. Walter bought 10 apples, and ate 4 of them; how many apples then remained?

6. Twelve boys were playing ball, when 4 of them left; how many remained?

7. Write the subtraction table by fours, on the blackboard or on your slates, using the signs — and =.

8. Count backward by 4's, from 16 to zero; from 15 to 3; from 14 to 2; from 13 to 1.

WRITTEN EXERCISES.

From	6	7	5	8	9	4	10	12	14	16	13	11	14
Take	4	4	4	4	4	4	4	4	4	4	4	4	4

From	65	79	87	99	58	69	75	98	76
Take	41	34	23	43	22	43	24	14	13
From	89	69	78	64	46	79	84	65	79
Take	41	34	42	31	34	33	32	20	40

Note.—Drill the pupils in reading and writing numbers from 10 to 100.

LESSON VIII.

Adding by Fives.

HOW many pens are 2 pens and 5 pens?

SOLUTION.—Two pens and 5 pens are 7 pens.

2. How many are 2 and 5? 4 and 5? 1 and 5? 3 and 5? 6 and 5? 8 and 5?

3. How many are 5 and 5? 10 and 5? 12 and 5? 9 and 5? 11 and 5? 7 and 5?

ADDITION TABLE.

1 and 5 are 6
2 and 5 are 7
3 and 5 are 8
4 and 5 are 9
5 and 5 are 10
6 and 5 are 11
7 and 5 are 12
8 and 5 are 13
9 and 5 are 14
10 and 5 are 15
11 and 5 are 16
12 and 5 are 17

4. If Mary has 3 books at school and 5 books at home; how many books has she in all?

5. James has 6 cents in a box, and 5 cents in his pocket; how many cents has he?

6. Maria had 8 needles and her sister gave her 5 needles; how many needles had she then?

7. Count forward by 5's from 5 to 15; from 1 to 16; from 2 to 17; from 3 to 13, from 4 to 14.

8. Write the addition table for fives on the board, using + and =.

WRITTEN EXERCISES.

5	5	5	5	5	5	5	5	5	5
+2	+4	+6	+8	+9	+5	+7	+10	+12	+11

55	45	53	25	15	52	56	68
+33	+31	+42	+44	+23	+25	+41	+31

Add	5	3	3	12	22	41	51	24
	3	4	2	20	33	26	37	33
	4	6	7	35	14	20	10	42

NOTE.—The teacher will drill pupils in reading and writing numbers from 10 to 100.

LESSON IX.

Subtracting by Fives.

HOW many are 5 marbles taken from 7 marbles?

SOLUTION.—Five marbles from 7 marbles leave 2 marbles.

2. How many are 5 taken from 6? 5 from 8? 5 from 5? 5 from 9? 5 from 7? 5 from 10? 5 from 12?

3. How many are 5 from 11? 5 from 13? 5 from 17? 5 from 14? 5 from 16? 5 from 18?

SUBTRACTION TABLE.

5 from 6 leaves 1
5 from 7 leaves 2
5 from 8 leaves 3
5 from 9 leaves 4
5 from 10 leaves 5
5 from 11 leaves 6

5 from 12 leaves 7
5 from 13 leaves 8
5 from 14 leaves 9
5 from 15 leaves 10
5 from 16 leaves 11
5 from 17 leaves 12

4. James is 9 years old and his sister is 5 years younger; how old is his sister?

5. Philo having 11 chestnuts, gave his brother 5 chestnuts; how many chestnuts did he retain?

6. Ada culled 14 roses and gave Willis 5 of them; how many roses did Ada retain?

7. Count backward by 5's from 15 to zero; from 14 to 4; from 13 to 3; from 16 to 1; from 17 to 2.

8. Write the subtraction table by fives upon the blackboard or slates.

WRITTEN EXERCISES.

From	6	7	9	8	10	5	12	14	11	13	15	16	17
Take	5	5	5	5	5	5	5	5	5	5	5	5	5

From	20	19	25	28	37	48	55	68	76	99
Take	5	5	5	5	5	5	5	5	15	25

From	234	244	369	427	254	452	475	500
Take	122	143	144	321	132	122	251	300

One Hundred	***Two Hundred***	***Three Hundred***	***Five Hundred***
100	*200*	*300*	*500*

NOTE.—The teacher will show pupils how to write numbers from 100 to 500.

LESSON X.

Adding by Sixes.

HOW many birds are 2 birds and 6 birds?

SOLUTION.—Two birds and 6 birds are 8 birds.

2. How many are 2 and 6? 4 and 6? 6 and 6? 5 and 6? 3 and 6? 1 and 6?

3. How many are 7 and 6? 9 and 6? 11 and 6? 8 and 6? 10 and 6? 12 and 6?

ADDITION TABLE.

1 and 6 are 7
2 and 6 are 8
3 and 6 are 9
4 and 6 are 10
5 and 6 are 11
6 and 6 are 12

7 and 6 are 13
8 and 6 are 14
9 and 6 are 15
10 and 6 are 16
11 and 6 are 17
12 and 6 are 18

4. Sally had 5 pins in her cushion, and put in 6 more pins; how many pins were then in the cushion?

5. Rose gave 7 pinks to Jennie, and 6 pinks to Fannie; how many pinks did she give away?

6. There are 10 girls in one class, and 6 girls in another class; how many girls are there in both?

7. Count forward by 6's from 6 to 18; from 5 to 17; from 4 to 16; from 3 to 15; from 2 to 14; from 1 to 13.

8. Write the addition table by sixes on the blackboard or on your slates, using the signs + and =.

WRITTEN EXERCISES.

Add			6	6	6	6	6	6	6	6	6	6
	2	4	3	1	6	5	8	7	10	11	9	12

Add	65	66	16	56	45	64	53	65	74
	43	82	21	31	64	74	72	84	65

Add	25	36	26	28	38	46	35	43	56
	7	8	8	16	26	17	28	29	34

NOTE.—In the last row of examples, there is something "to carry." The teachers will explain the method so that the pupil may understand the reason for "carrying."

LESSON XI.

Subtracting by Sixes.

HOW many does 6 taken from 8 leave?

SOLUTION.—Six taken from 8 leaves 2.

2. Six from 7 leaves how many? 6 from 9? 6 from 11? 6 from 8? 6 from 10? 6 from 12?

3. Six from 13 leaves how many? 6 from 15? 6 from 14? 6 from 17? 6 from 16? 6 from 18?

SUBTRACTION TABLE.

6 from 7 leaves 1
6 from 8 leaves 2
6 from 9 leaves 3
6 from 10 leaves 4
6 from 11 leaves 5
6 from 12 leaves 6
6 from 13 leaves 7
6 from 14 leaves 8
6 from 15 leaves 9
6 from 16 leaves 10
6 from 17 leaves 11
6 from 18 leaves 12

4. Maria bought 11 apples, and gave Edward 6 of them; how many apples did Maria keep?

5. If you make 12 marks on your slate and rub out 6 of them, how many marks will remain?

6. Harold is 6 years old and Corinne is 13; what is the difference between their ages?

7. Count backward by 7's from 18 to 4; from 17 to 3; from 16 to 2; from 15 to 1.

8. Write the subtraction table by sixes on the blackboard or your slates, using the signs — and =.

WRITTEN EXERCISES.

From	8	7	9	10	6	11	13	14	12	15	18	17	16
Take	6	6	6	6	6	6	6	6	6	6	6	6	6

From	94	89	75	93	87	128	107	156	145	128
Take	33	56	61	60	66	64	63	54	63	56

From	524	643	651	782	739	876	584	849
Take	213	312	235	351	516	534	423	315

Six Hundred	*Seven Hundred*	*Eight Hundred*	*One Thousand*
600	*700*	*800*	*1000*

NOTE.—The teacher will drill the pupils in reading and writing numbers from 600 to 1000.

LESSON XII.

Adding and Subtracting by Sevens.

HOW many are 1 and 7? 2 and 7? 4 and 7? 6 and 7? 5 and 7? 3 and 7?

2. How many are 7 and 7? 10 and 7? 13 and 7? 8 and 7? 12 and 7? 9 and 7?

ADDITION TABLE.

1 and 7 are 8
2 and 7 are 9
3 and 7 are 10
4 and 7 are 11
5 and 7 are 12
6 and 7 are 13
7 and 7 are 14
8 and 7 are 15
9 and 7 are 16
10 and 7 are 17
11 and 7 are 18
12 and 7 are 19

3. There are 3 birds on one tree and 7 birds on another tree; how many birds are there on both trees?

4. There are 9 sheep in one field, and 7 sheep in another field; how many sheep are there in both fields?

5. How many are 7 from 8? 7 from 9? 7 from 10? 7 from 12? 7 from 11? 7 from 13?

6. How many are 7 from 14? 7 from 16? 7 from 19? 7 from 17? 7 from 15? 7 from 18?

7. Write the subtraction table by 7's on the blackboard or slate, using the symbols — and =.

8. There were 10 sheep in a field, and seven of them jumped out; how many sheep remained in the field?

9. Jane culled 7 roses from a bush containing 12 roses; how many roses remained on the bush?

WRITTEN EXERCISES.

Add	67 58	57 78	37 42	307 435	507 438	747 235	358 613	639 354

Add	36 40 63	37 44 21	72 24 68	32 74 30	42 65 72	43 54 25	74 35 62	327 142 804	134 243 332
Subtract	15 7	18 7	48 37	138 74	149 75	120 70	158 56	289 75	500 300

NOTE.—Drill in reading and writing numbers up to 1000.

LESSON XIII.

Adding and Subtracting by Eights.

HOW many are 3 and 8? 1 and 8? 5 and 8? 2 and 8? 4 and 8? 6 and 8?

2. How many are 8 and 8? 10 and 8? 12 and 8? 9 and 8? 11 and 8? 5 and 8?

ADDITION TABLE.

1 and 8 are 9
2 and 8 are 10
3 and 8 are 11
4 and 8 are 12
5 and 8 are 13
6 and 8 are 14

7 and 8 are 15
8 and 8 are 16
9 and 8 are 17
10 and 8 are 18
11 and 8 are 19
12 and 8 are 20

3. Mary has 7 credit marks, and her brother has 8; how many credit marks have both?

4. A cat caught 5 mice one day, and 8 the next; how many mice did she catch in both days?

5. Eight from 12 leaves how many? 8 from 10? 8 from 13? 8 from 9? 8 from 11? 8 from 16?

6. Eight from 18 leaves how many? 8 from 17? 8 from 19? 8 from 20? 8 from 17? 8 from 14?

7. Write the subtraction table by 8's on the blackboard or slate, using the symbols — and =.

8. If there are 10 swallows on the barn, and 8 of them fly away; how many swallows will remain?

9. There were 12 persons at dinner, and 8 of them left the table; how many persons remained?

WRITTEN EXERCISES.

Add	58	68	78	108	408	248	511	127
	24	33	83	834	236	625	342	643

	85	78	53	328	242	175	200
Add	34	63	38	226	323	402	300
	46	25	44	430	164	325	500

Sub-	17	15	59	125	136	175	168	407	839
tract	8	8	38	82	84	83	84	305	615

NOTE.—Drill in reading and writing numbers as far as 1000.

LESSON XIV.

Adding and Subtracting by Nines.

HOW many are 2 and 9? 5 and 9? 3 and 9? 6 and 9? 1 and 9? 4 and 9?

2. How many are 7 and 9? 9 and 9? 8 and 9? 10 and 9? 11 and 9? 12 and 9?

ADDITION TABLE.

1 and 9 are 10
2 and 9 are 11
3 and 9 are 12
4 and 9 are 13
5 and 9 are 14
6 and 9 are 15
7 and 9 are 16
8 and 9 are 17
9 and 9 are 18
10 and 9 are 19
11 and 9 are 20
12 and 9 are 21

3. There were 6 boys playing ball and 9 boys looking on; how many boys were there in all?

4. There are 8 boys and 9 girls in a class; how many pupils in the class?

5. Peter lost 11 marbles, and then had 8 marbles remaining; how many marbles had he at first?

6. Nine from 11 leaves how many? 9 from 13? 9 from 10? 9 from 14? 9 from 16? 9 from 18?

7. Nine from 15 leaves how many? 9 from 17? 9 from 20? 9 from 19? 9 from 12? 9 from 21?

8. Write the subtraction table for 9's on the slate or blackboard, using the symbols — and =.

9. A boy having 12 pears, gave 9 of them to his teacher; how many pears did he retain?

WRITTEN EXERCISES.

Add	49	59	98	109	509	319	715	485
	35	64	42	327	384	673	207	463

	96	98	93	87	94	89	64	64	98
Add	34	47	44	34	63	37	43	25	54
	47	34	36	79	42	90	48	46	12

Subtract	18	17	20	134	128	114	148	157	186	200
	9	9	9	93	96	91	97	96	93	90

LESSON XV.

Adding and Subtracting by Tens.

HOW many are 2 and 10? 4 and 10? 6 and 10? 3 and 10? 1 and 10? 5 and 10?

2. How many are 7 and 10? 9 and 10? 8 and 10? 10 and 10? 12 and 10? 11 and 10?

ADDITION TABLE.

1 and 10 are 11
2 and 10 are 12
3 and 10 are 13
4 and 10 are 14
5 and 10 are 15
6 and 10 are 16
7 and 10 are 17
8 and 10 are 18
9 and 10 are 19
10 and 10 are 20
11 and 10 are 21
12 and 10 are 22

3. A boy lost 3 birds, and a man lost 10 birds; how many birds did both lose?

4. In a field there are 11 young cows and 10 old ones; how many cows are there in the field?

5. Ten from 12 leaves how many? 10 from 13? 10 from 15? 10 from 11? 10 from 14? 10 from 16?

6. Ten from 18 leaves how many? 10 from 20? 10 from 19? 10 from 17? 10 from 22? 10 from 21?

7. Write the subtraction table by 10's on the slate or blackboard, using the symbols — and =.

8. Annie's book contained 14 pages and her dog tore out 10 pages; how many pages remained?

9. A hunter shot 10 robins from a flock of 20 robins; how many robins were not shot?

WRITTEN EXERCISES.

Add	104 52	107 62	105 78	108 89	410 312	510 409	610 311	1010 909
Sub-tract	18 10	20 10	30 10	426 310	329 103	456 105	497 310	564 240

Two Thousand,	***Three Thousand,***	***Five Thousand.***
2000	*3000*	*5000*

NOTE.—Drill in reading and writing numbers up to 5000.

LESSON XVI.

Adding and Subtracting by Elevens.

HOW many are 2 and 11? 4 and 11? 1 and 11? 6 and 11? 3 and 11? 5 and 11?

2. How many are 7 and 11? 10 and 11? 8 and 11? 9 and 11? 12 and 11? 11 and 11?

ADDITION TABLE.

1 and 11 are 12
2 and 11 are 13
3 and 11 are 14
4 and 11 are 15
5 and 11 are 16
6 and 11 are 17
7 and 11 are 18
8 and 11 are 19
9 and 11 are 20
10 and 11 are 21
11 and 11 are 22
12 and 11 are 23

3. There are 5 teachers in one school and 11 in another school; how many teachers in both schools?

4. In a bouquet there are 9 roses and 11 pinks; how many flowers in the bouquet?

5. Eleven from 12 leaves how many? 11 from 15? 11 from 17? 11 from 16? 11 from 14? 11 from 13?

6. Eleven from 19 leaves how many? 11 from 21? 11 from 22? 11 from 20? 11 from 18? 11 from 23?

7. Write the subtraction table by 11's on the slate or blackboard, using the symbols — and =.

8. John had 16 marbles and gave 11 of them away, how many had he left?

9. Of twenty men who went to war, 11 were killed; how many were not killed?

WRITTEN EXERCISES.

Add	113 84	117 79	116 47	129 34	812 408	711 504	912 610	512 906
Subtract	23 12	19 14	48 15	324 201	637 215	728 503	649 506	800 300

Six Thousand,	*Seven Thousand,*	*Ten Thousand.*
6000	*7000*	*10000*

NOTE.—Drill in reading and writing numbers up to 10000.

LESSON XVII.

Adding and Subtracting by Twelves.

HOW many are 1 and 12? 3 and 12? 5 and 12? 2 and 12? 4 and 12? 6 and 12?

2. How may are 8 and 12? 10 and 12? 7 and 12? 11 and 12? 9 and 12? 12 and 12?

ADDITION TABLE.

1 and 12 are 13
2 and 12 are 14
3 and 12 are 15
4 and 12 are 16
5 and 12 are 17
6 and 12 are 18

7 and 12 are 19
8 and 12 are 20
9 and 12 are 21
10 and 12 are 22
11 and 12 are 23
12 and 12 are 24

3. A house has 8 windows on one side and 12 on the other side; how many windows on both sides?

4. Mary has 10 cents in her pocket-book, and 12 cents in a money-box; how many cents has she?

5. Twelve from 13 leaves how many? 12 from 15? 12 from 16? 12 from 19? 12 from 14? 12 from 17?

6. Twelve from 20 leaves how many? 12 from 18? 12 from 21? 12 from 24? 12 from 23? 12 from 22?

7. Write the subtraction table by 12's on the slate or blackboard, using the symbols — and =.

8. There were 16 birds in the barn, and 12 of them flew away; how many birds then remained?

WRITTEN EXERCISES.

Add	225	615	706	369	756	808	465	867
	347	392	154	128	427	147	587	259
From	352	653	764	965	876	735	548	436
Take	218	427	538	437	538	482	276	275
From	548	625	857	768	632	743	850	800
Take	263	264	365	485	254	265	567	543

NOTE.—In these problems in subtraction, some of the terms in the subtrahend exceed the corresponding terms in the minuend. The teacher will explain the method of subtracting.

LESSON XVIII.

Leading to the Terms.

THE following exercises are designed to suggest to the teacher the manner of giving the *terms* employed in addition and subtraction, and deriving some of the *principles* of both.

TEACHER: When I take some objects in my hand, and ask you how many I have, the word which you use before the name of the objects, in answering my question, denotes a *number*. A number, then, is how many there are in a collection. A single thing, or *one* of a collection, is called a *unit*.

TEACHER: When I say two apples, what 2 do I mean?

PUPILS: Two *apples*.

TEACHER: When I say *two* what do I mean?

PUPILS: We do not know.

TEACHER: What 2 may I mean? *any* two?

PUPILS: Yes, sir, any two you choose.

TEACHER: You see a difference, then, between *two*, and *two books;* very well, I will give the name which denotes this difference. When I say 2, 3, etc., without telling what 2 or 3, it is called an *abstract number*, but when I give the name of the objects with the number it is called a *concrete number*.

Tell which of the following numbers are *abstract* and which *concrete:*

2 *cows—three—four*—4 *books*—7 *hens—eight*—5—4—10 *pigs*—8 *geese*—7—6—11—14 *horses.*

TEACHER: How many are 3 and 5?

TEACHER: When we unite two numbers into one, in this way, the result is called the *sum*, and the process is called ADDITION.

TEACHER: What is the sum of 2 and 3? 4 and 6? 7 and 8?

TEACHER: What is the sum of 3 *cows* and 5 *turnips?*

TEACHER: Why can you not add them?

TEACHER: If they were all the same could you add them?

TEACHER: Numbers which express the same kind of objects are *similar concrete* numbers, and those which denote different objects are *dissimilar concrete* numbers.

Teacher: What kind of numbers can be added then, and what kind cannot be added?

How many remain when we take 3 apples from 5 apples?

The process of taking one number from another is called SUBTRACTION.

The number which is taken away is called the SUBTRAHEND.

If you subtract 4 from 9, which is the *minuend*, which the *subtrahend*, and which the *remainder?*

If you add the remainder and subtrahend together, will it produce the minuend?

If you subtract the difference from the minuend, what will it equal?

Can you subtract 3 *apples* from 5 *potatoes?*

Why can you not subtract them?

Are these *similar* or *dissimilar* concrete numbers?

If they were *similar*, could they be subtracted?

What kind of numbers, then, can be subtracted, and what kind cannot?

To denote the equality of numbers, and operations performed upon them, we use certain signs or symbols.

The symbol = is the sign of *equality*, and is read *equals;* thus, 1 dollar = 10 dimes, is read, 1 dollar *equals* 10 dimes.

The symbol + is the sign of *addition*, and is read *plus;* thus, $3 + 4 = 7$, is read, 3 *plus* 4 equals 7.

The symbol — is the sign of *subtraction*, and is read *minus;* thus, $5 - 2 = 3$, is read, 5 *minus* 2 equals 3.

What is the value of

1. 2 + 2?
2. 3 + 3?
3. 4 + 4?
4. 5 + 5?
5. 6 + 6?
6. 7 + 7?
7. 8 + 8?
8. 9 + 9?
9. 2 + 2 + 2?
10. 3 + 3 + 3?
11. 5 + 5 + 5?
12. 6 + 6 + 6?
13. 8 + 8 + 8?
14. 9 + 9 + 9?
15. 10 + 10 + 10?
16. 11 + 11 + 11?
17. 2 + 2 + 2 + 2?
18. 3 + 3 + 3 + 3?
19. 4 + 4 + 4 + 4?
20. 5 + 5 + 5 + 5?
21. 7 + 7 + 7 + 7?
22. 8 + 8 + 8 + 8?
23. 9 + 9 + 9 + 9?
24. 10 + 10 + 10 + 10?

Remark.—It will be a good exercise for the teacher to write questions, similar to the above, on the board. Let the other symbols be also used in forming exercises. The adding of a number of ***twos, threes,*** etc., will be a valuable introduction to multiplication.

SECTION III.

MULTIPLICATION AND DIVISION.

INTRODUCTION

Suggestions to Teachers.

THE first introduction in Multiplication and Division should be given by oral exercises, and in accordance with the following principles.

1. *Multiplication should be taught as a special case of Addition.* Thus, the pupil should be taught that two 2's are 4, since $2 + 2 = 4$; or that three times 2 are 6, since $2 + 2 + 2 = 6$, etc. The pupil will then understand the nature of the subject, and see its relation to addition.

2. *Division should be taught as reverse Multiplication.* Thus, it should be shown that 6 contains 3 *two* times, since *two* times 3 are 6; and that 12 contains 4 *three* times, since *three* times 4 are 12, etc. In this way the pupil is led to derive the quotients directly from the products.

3. *The pupil should be taught to construct the Multiplication Table.* He should first be taught to derive the products for himself, by addition, and then be required to commit them, to avoid the labor of obtaining them every time he wishes to use them. In this way he will study them with more interest, and learn them with greater ease.

4. *Multiplication and Division should be taught simultaneously, or very nearly so.* As soon as the pupil learns that 2 times 3 are 6, he is able to see that 6 equals *two* 3's, or that 6 *contains* 3 *two times;* and the same is true for the other quotients and products. It is thus clear that Division should be taught in connection with Multiplication.

Pupils have considerable difficulty in committing the Multiplication Table; the teacher can lessen this labor in several ways. 1st. By having the pupils make it for themselves, and write it on the slate or blackboard. 2d. By concert recitations. 3d. By singing the table to some appropriate tune. 4th. By reciting it by the method of "going up" or "trapping."

To make pupils rapid and accurate in the mechanical processes of addition, subtraction, multiplication, and division, let the teacher write four columes of figures on the blackboard, the first column being additive, the next subtractive, etc., indicated by the symbols placed above them. The teacher will point to certain figures, the corresponding numbers being added, subtracted, multiplied, or divided, as is indicated by the symbol at the head of the column.

LESSON I.

Multiplying by Two.

IF you have 3 cents in your hand and 3 cents in your pocket, how many *times* 3 cents have you?

2. How many cents are *two times* 3 cents?

SOLUTION.—Two times 3 cents are 6 cents, because 3 cents and 3 cents are 6 cents.

NOTE.—The pupil may *write the numbers* to be added upon the slate or blackboard, as in the margin.

$$\begin{array}{r}3\\ \underline{3}\\ 6\end{array}$$

3. How many are 2 times 1? 2 times 2? 2 times 3? 2 times 4? 2 times 5? 2 times 6?

4. How many are 2 times 7? 2 times 8? 2 times 9? 2 times 10? 2 times 11? 2 times 12?

MULTIPLICATION TABLE.

2 times 1 are 2	2 times 7 are 14
2 times 2 are 4	2 times 8 are 16
2 times 3 are 6	2 times 9 are 18
2 times 4 are 8	2 times 10 are 20
2 times 5 are 10	2 times 11 are 22
2 times 6 are 12	2 times 12 are 24

NOTE.—Drill the pupils on this table until they know it. Have them *make* the table and *write* it on the board, using the signs × and =; thus, 2 × 1 = 2, etc.

5. If 1 cow has 4 feet, how many feet have 2 cows?

SOLUTION.—If 1 cow has four feet, 2 cows have 2 times 4 feet, which are 8 feet.

6. If on one hand there are 5 fingers, how many fingers are on 2 hands?

7. If one little boy has 10 toes, how many toes have 2 little boys?

WRITTEN EXERCISES.

2	4	3	5	6	7	8	9	10	11	12
2	2	2	2	2	2	2	2	2	2	2

21	22	31	34	42	41	52	54	64
2	2	2	2	2	2	2	2	2

NOTE.—Continue the drill in reading and writing numbers up to 10,000.

LESSON II.

Dividing for Quotients of Two.

HOW many times 2 cents in 4 cents?

SOLUTION.—There are *two times* 2 cents in 4 cents, because *two times* 2 cents are 4 cents.

2. How many times 1 cent in 2 cents? 2 in 4? 3 in 6? 4 in 8? 5 in 10?

3. How many times 6 in 12? 7 in 14? 8 in 16? 9 in 18? 10 in 20? 11 in 22? 12 in 24?

DIVISION TABLE.

1 in 2, 2 times
2 in 4, 2 times
3 in 6, 2 times
4 in 8, 2 times
5 in 10, 2 times
6 in 12, 2 times
7 in 14, 2 times
8 in 16, 2 times
9 in 18, 2 times
10 in 20, 2 times
11 in 22, 2 times
12 in 24, 2 times

NOTE.—Drill the pupils on this table. Have them write it on the board, using the symbols ÷ and =; thus, 6 ÷ 3 = 2, etc. They should derive it from the table of products.

4. If one apple costs 3 cents, how many apples can you buy for 6 cents?

SOLUTION.—You can buy as many apples as 3 cents are contained times in 6 cents, which are 2 times. Hence you can buy 2 apples.

5. At 6 cents each, how many primary spelling books can be bought for 12 cents?

6. If one chair costs 5 dollars, how many chairs can be bought for 10 dollars?

7. How many benches will seat 16 pupils, if there are 8 pupils on each bench?

WRITTEN EXERCISES.

2)4 3)6 4)8 5)10 6)12 7)14 8)16 9)18 10)20 11)22 12)24

2)24 3)36 4)48 5)50 6)120 7)140 8)168 9)189

2)402 3)306 4)408 5)1005 6)1206 7)1407

NOTE.—Drill in reading and writing numbers up to 10,000.

LESSON III.

Multiplying by Three.

IF one peach costs 2 cents, how many times 2 cents will 3 peaches cost?

2. How many are three times 2?

SOLUTION.—Three times 2 are 6, since the sum of three 2's is 6.

3. How many are 3 times 1? 3 times 3? 3 times 4? 3 times 5? 3 times 6?

4. How many are 3 times 7? 3 times 8? 3 times 9? 3 times 10? 3 times 11? 3 times 12?

MULTIPLICATION TABLE.

3 times 1 are 3
3 times 2 are 6
3 times 3 are 9
3 times 4 are 12
3 times 5 are 15
3 times 6 are 18
3 times 7 are 21
3 times 8 are 24
3 times 9 are 27
3 times 10 are 30
3 times 11 are 33
3 times 12 are 36

5. If 1 book costs 6 cents, what will 3 books cost?

SOLUTION.—If 1 book costs 6 cents, 3 books will cost 3 times 6 cents, which are 18 cents.

6. If Jane gave 7 cents for one doll, how much would she give for 3 dolls?

7. How many cents will 3 yards of ribbon cost, if one yard is worth 10 cents?

8. If a horse eats 11 quarts of oats a week, how many quarts will he eat in 3 weeks?

9. Write the multiplication table of *threes*, using × for *times* and = for *are*.

WRITTEN EXERCISES.

2	4	3	5	6	7	8	9	10	11	12
3	3	3	3	3	3	3	3	3	3	3

23	32	13	20	52	61	72	53	80	93
3	3	3	3	3	3	3	3	3	3

503	712	801	604	703	856	400	800
3	3	3	2	3	1	3	2

LESSON IV.

Dividing for Quotients of Three.

HOW many times are 2 cents contained in 6 cents?

SOLUTION.—Two cents are contained 3 times in 6 cents, because 3 times 2 cents are 6 cents.

2. How many times are 3 contained in 9? 5 in 15? 6 in 12? 7 in 14? 6 in 18? 9 in 18? 10 in 20?

3. How many times are 7 contained in 21? 8 in 24? 9 in 27? 11 in 33? 10 in 30? 12 in 36?

DIVISION TABLE.

1 in 3, 3 times
2 in 6, 3 times
3 in 9, 3 times
4 in 12, 3 times
5 in 15, 3 times
6 in 18, 3 times
7 in 21, 3 times
8 in 24, 3 times
9 in 27, 3 times
10 in 30, 3 times
11 in 33, 3 times
12 in 36, 3 times

4. At 4 cents each, how many melons can I buy for 12 cents?

SOLUTION.—I can buy as many melons as 4 is contained times in 12, which are 3.

5. If one yard of tape costs 5 cents, how many yards of tape can I buy for 10 cents?

6. How many apples can I buy for 21 cents, at the rate of 7 cents each?

7. How many yards of ribbon, at 8 cents a yard, can be bought for 16 cents?

8. Write the division table of *threes*, using ÷ for *divided by* and = for *are;* thus, 6 ÷ 3 = 2 etc.

WRITTEN EXERCISES.

1)3 2)6 4)12 5)15 6)18 7)21 8)24 9)27 10)30

3)369 2)428 3)639 4)804 3)609 2)624

4)128 5)155 8)168 6)126 7)1407 8)1608

NOTE.—Drill in reading and writing numbers up to 10,000.

LESSON V.

Multiplying by Four.

IF one pear is worth 2 cents, how many times 2 cents are 4 pears worth?

2. How many are 4 times 2?

SOLUTION.—Four times 2 are 8, because the sum of four 2's is 8.

3. How many are 4 times 1? 4 times 3? 4 times 2? 4 times 4? 4 times 5? 4 times 6?

4. How many are 4 times 7? 4 times 8? 4 times 9? 4 times 10? 4 times 11? 4 times 12?

MULTIPLICATION TABLE.

4 times 1 are 4
4 times 2 are 8
4 times 3 are 12
4 times 4 are 16
4 times 5 are 20
4 times 6 are 24
4 times 7 are 28
4 times 8 are 32
4 times 9 are 36
4 times 10 are 40
4 times 11 are 44
4 times 12 are 48

5. If one lemon cost 5 cents, how many cents will 4 lemons cost?

6. If there are 6 roses on one bush, how many roses are there on 4 bushes?

7. Mary had 7 pins, and Jane had 4 times as many; how many pins had Jane?

8. If one loaf of bread costs 10 cents, how many cents will 4 loaves cost?

9. Write the table of four times on the slate or blackboard, using × and =.

WRITTEN EXERCISES.

32	41	52	502	320	702	801
4	4	4	4	4	4	4
314	523	725	852	726	834	709
4	4	3	4	2	3	4

NOTE.—In the last row of examples we are required "to carry," which the teacher will explain to the pupils.

LESSON VI.

Dividing for Quotients of Four.

HOW many times are 3 contained in 12?

SOLUTION.—3 are contained in 12 *four* times, because 4 times 3 are 12.

2. How many times are 2 contained in 8? 3 in 12? 5 in 20? 4 in 24? 6 in 24? 8 in 16? 7 in 28? 9 in 36?

3. How many times are 8 contained in 32? 10 in 30? 11 in 44? 12 in 48? 12 in 36? 10 in 40? 11 in 22?

DIVISION TABLE.

1 in 4, 4 times
2 in 8, 4 times
3 in 12, 4 times
4 in 16, 4 times
5 in 20, 4 times
6 in 24, 4 times
7 in 28, 4 times
8 in 32, 4 times
9 in 36, 4 times
10 in 40, 4 times
11 in 44, 4 times
12 in 48, 4 times

4. If a bird flies a mile in 3 minutes, how far will it fly in 12 minutes?

5. If a man walks 5 miles in one hour, how long will it take him to walk 20 miles?

6. If one ball costs 9 cents, how many balls can be bought for 36 cents?

7. How many shelves will it require for 48 books, if there are 12 books on each shelf?

8. Fill out the following upon the slate or blackboard:

4 ÷ 1 = ?
8 ÷ 2 = ?
12 ÷ 3 = ?
16 ÷ 4 = ?
20 ÷ 5 = ?
24 ÷ 6 = ?
28 ÷ 7 = ?
32 ÷ 8 = ?
36 ÷ 9 = ?
40 ÷ 10 = ?
44 ÷ 11 = ?
48 ÷ 12 = ?

WRITTEN EXERCISES.

1)4 2)8 3)12 4)16 5)20 6)24 7)28 8)32 9)36

2)48 3)36 4)160 6)246 7)287 8)328 9)369

3)126 4)128 9)180 3)276 7)280 4)408 5)1005

2)2640 4)8480 4)1280 3)1206 5)1500

LESSON VII.

Multiplying by Five.

IF one apple costs 2 cents, how many times 2 cents will 5 apples cost?

2. How many are 5 times 2?

SOLUTION.—Five times 2 are 10, because the sum of five 2's is 10.

3. How many are 5 times 1? 5 times 2? 5 times 3? 5 times 4? 5 times 5? 5 times 6?

4. How many are 5 times 7? 5 times 8? 5 times 9? 5 times 10? 5 times 11? 5 times 12?

MULTIPLICATION TABLE.

5 times 1 are 5	5 times 7 are 35
5 times 2 are 10	5 times 8 are 40
5 times 3 are 15	5 times 9 are 45
5 times 4 are 20	5 times 10 are 50
5 times 5 are 25	5 times 11 are 55
5 times 6 are 30	5 times 12 are 60

5. If one book costs 4 cents, how many cents must I pay for 5 books?

6. If one line of printing contains 7 words, how many words are there in 5 such lines?

7. If a man can walk six miles in one hour, how far can he walk in 5 hours?

8. If in one quart there are 2 pints, how many pints are there in 5 quarts?

9. Write the table of five times on the slate or blackboard, using × and =.

WRITTEN EXERCISES.

31	42	64	324	603	240	304	906
5	5	5	5	5	5	5	5
428	307	809	412	610	424	560	527
2	3	5	4	5	3	5	5

NOTE.—Let the teacher show the pupils how to "carry," in the last row of problems.

LESSON VIII.

Dividing for Quotients of Five.

HOW many times are 3 contained in 15?

Solution.—3 are contained 5 times in 15, because 5 times 3 are 15.

2. How many times are 2 contained in 10? 4 in 20? 5 in 15? 6 in 30? 3 in 15? 7 in 28? 9 in 45?

3. How many times are 6 contained in 24? 7 in 21? 8 in 40? 7 in 35? 9 in 36? 10 in 50? 12 in 60?

DIVISION TABLE.

1 in 5, 5 times
2 in 10, 5 times
3 in 15, 5 times
4 in 20, 5 times
5 in 25, 5 times
6 in 30, 5 times
7 in 35, 5 times
8 in 40, 5 times
9 in 45, 5 times
10 in 50, 5 times
11 in 55, 5 times
12 in 60, 5 times

4. How many books can I buy for 50 cents, at the rate of 10 cents apiece?

5. How many pairs of boots, at 6 dollars a pair, can you buy for 24 dollars?

6. If there are 8 quarts in one peck, how many pecks are there in 40 quarts?

7. How many hours must a boat sail to go 36 miles, at the rate of 9 miles an hour?

8. Put the proper numbers after the symbol ÷ in the following:

5 ÷ 1 = 5
10 ÷ ? = 5
15 ÷ ? = 5
20 ÷ ? = 5
25 ÷ ? = 5
30 ÷ ? = 5
35 ÷ ? = 5
40 ÷ ? = 5
45 ÷ ? = 5
50 ÷ ? = 5
55 ÷ ? = 5
60 ÷ ? = 5

WRITTEN EXERCISES.

1)5 2)10 3)15 4)20 5)25 6)30 7)35 8)40 9)45
5)55 8)80 4)124 5)250 8)248 9)279 4)808
3)129 7)217 6)240 5)205 2)408 6)306 7)2107
3)3639 4)4844 5)1500 6)1200 7)3514

LESSON IX.

Multiplying by Six.

IF one melon is worth 3 cents, how many times 3 cents are 6 melons worth?

2. How many are 6 times 3?

SOLUTION.—Six times 3 are 18, because the sum of six 3's is 18.

3. How many are 6 times 1? 6 times 2? 6 times 4? 6 times 5? 6 times 6?

4. How many are 6 times 7? 6 times 8? 6 times 9? 6 times 10? 6 times 11? 6 times 12?

MULTIPLICATION TABLE.

6 times 1 are 6
6 times 2 are 12
6 times 3 are 18
6 times 4 are 24
6 times 5 are 30
6 times 6 are 36
6 times 7 are 42
6 times 8 are 48
6 times 9 are 54
6 times 10 are 60
6 times 11 are 66
6 times 12 are 72

5. If Henry learns 4 lessons a day, how many lessons would he learn in 6 days?

6. If 5 yards of cloth make a coat, how many yards will make 6 coats?

7. If a stage goes 8 miles in one hour, how far, at this rate, will it go in 6 hours?

8. There are 12 pence in one shilling; how many pence are there in 6 shillings?

9. Write the table of six times on the slate or blackboard, using the symbols × and =.

WRITTEN EXERCISES.

2	3	4	5	6	7	8	9	10	11	12
6	6	6	6	6	6	6	6	6	6	6

22	43	54	423	745	810	246	257	270
6	6	6	6	6	6	6	6	6

348	354	426	357	845	954	747
5	4	5	2	3	2	5

LESSON X.

Dividing for Quotients of Six.

HOW many times are 5 contained in 30?

SOLUTION.—5 are contained 6 times in 30, because 6 times 5 are 30.

2. How many times are 3 contained in 18? 7 in 21? 8 in 24? 4 in 24? 9 in 36? 7 in 42? 9 in 54?

3. How many times are 12 contained in 24? 11 in 66? 7 in 42? 10 in 40? 8 in 48? 4 in 12? 10 in 60? 11 in 55?

DIVISION TABLE.

1 in 6, 6 times	7 in 42, 6 times
2 in 12, 6 times	8 in 48, 6 times
3 in 18, 6 times	9 in 54, 6 times
4 in 24, 6 times	10 in 60, 6 times
5 in 30, 6 times	11 in 66, 6 times
6 in 36, 6 times	12 in 72, 6 times

4. If there are 2 pints in one quart, how many quarts are there in 12 pints?

5. Mary's doll cost 10 cents; how many dolls could she buy for 60 cents?

6. There are seven days in one week; how many weeks are there in 35 days?

7. In an orchard there are 48 trees, and 8 trees in a row; how many rows in the orchard?

8. Put the proper numbers after the division sign in the following.

6 ÷ ? = 6   24 ÷ ? = 6   42 ÷ ? = 6   60 ÷ ? = 6
12 ÷ ? = 6   30 ÷ ? = 6   48 ÷ ? = 6   66 ÷ ? = 6
18 ÷ ? = 6   36 ÷ ? = 6   54 ÷ ? = 6   72 ÷ ? = 3

WRITTEN EXERCISES.

1)6   2)12   3)18   4)24   5)30   6)36   7)42   8)48   9)54
6)42   3)42   4)56   6)72   7)98   8)104   9)117   6)240
3)396   8)488   9)549   7)427   6)366   5)305   6)360
4)3220   3)9630   5)2515   6)2406   7)1421

LESSON XI.

Multiplying by Seven.

IF one pen is worth 2 cents, how many times 2 cents are 7 pens worth?

2. How many are 7 times 2?

SOLUTION.—Seven times 2 are 14, since the sum of seven 2's is 14.

3. How many are 7 times 1? 7 times 3? 7 times 4? 7 times 5? 7 times 6?

4. How many are 7 times 7? 7 times 8? 7 times 9? 7 times 10? 7 times 11? 7 times 12?

MULTIPLICATION TABLE.

7 times 1 are 7
7 times 2 are 14
7 times 3 are 21
7 times 4 are 28
7 times 5 are 35
7 times 6 are 42
7 times 7 are 49
7 times 8 are 56
7 times 9 are 63
7 times 10 are 70
7 times 11 are 77
7 times 12 are 84

5. How much is the postage on 7 letters, if the postage on each letter is 2 cents?

6. If in one window there are 6 lights, how many lights are there in 7 windows?

7. John walked 9 miles, and Henry walked 7 times as far; how far did Henry walk?

8. You have 8 bones in one wrist; how many bones have you in both wrists?

9. Write the table of seven times on the slate or blackboard, using the symbols × and =.

WRITTEN EXERCISES.

2	3	4	5	6	7	8	9	10	11	12
7	7	7	7	7	7	7	7	7	7	7

21	34	45	256	344	421	526	417
7	7	7	7	7	7	7	7

564	708	563	872	453	945	343
2	5	4	6	7	4	5

LESSON XII.

Dividing for Quotients of Seven.

HOW many times are 4 contained in 28?

SOLUTION.—Four are contained 7 times in 28, because 7 times 4 are 28.

2. How many times are 3 contained in 21? 6 in 18? 7 in 49? 5 in 20? 6 in 42? 8 in 56? 9 in 54?

3. How many times are 8 contained in 56? 6 in 30? 4 in 16? 10 in 70? 11 in 66? 5 in 35? 12 in 84?

DIVISION TABLE.

1 in 7, 7 times
2 in 14, 7 times
3 in 21, 7 times
4 in 28, 7 times
5 in 35, 7 times
6 in 42, 7 times
7 in 49, 7 times
8 in 56, 7 times
9 in 63, 7 times
10 in 70, 7 times
11 in 77, 7 times
12 in 84, 7 times

4. How many sheep, at 3 dollars a head, can be bought for 21 dollars?

5. If a boat sails 9 miles in one hour, how many miles will it sail in 7 hours?

6. If a tree yields 11 bushels of pears, how many pear-trees will it take to yield 55 bushels?

7. How many tops can James buy for 32 cents, at the rate of 8 cents apiece?

8. Put the proper numbers after the division sign in the following:

7 ÷ ? = 7   28 ÷ ? = 7   49 ÷ ? = 7   70 ÷ ? = 7
14 ÷ ? = 7   35 ÷ ? = 7   56 ÷ ? = 7   77 ÷ ? = 7
21 ÷ ? = ?   42 ÷ ? = 7   63 ÷ ? = 7   84 ÷ ? = 7

WRITTEN EXERCISES.

1)7   2)14   3)21   4)28   5)35   6)42   7)49   8)56   9)63
3)51   4)68   5)75   6)78   7)98   6)426   7)497   5)575
2)744   4)648   6)672   7)434   6)444   8)176   3)657

NOTE.—The teacher will show the pupils how to divide when there are remainders.

LESSON XIII.

Multiplying by Eight.

IF one top costs 2 cents, how many times 2 cents will 8 tops cost?

2. How many are 8 times 2?

SOLUTION.—Eight times 2 are 16, since the sum of eight 2's is 16.

3. How many are 8 times 1? 8 times 3? 8 times 4? 8 times 5? 8 times 6?

4. How many are 8 times 7? 8 times 8? 8 times 9? 8 times 10? 8 times 11? 8 times 12?

MULTIPLICATION TABLE.

8 times 1 are 8
8 times 2 are 16
8 times 3 are 24
8 times 4 are 32
8 times 5 are 40
8 times 6 are 48

8 times 7 are 56
8 times 8 are 64
8 times 9 are 72
8 times 10 are 80
8 times 11 are 88
8 times 12 are 96

5. If there are 4 gills in one pint, how many gills are there in 8 pints?

6. Mary sold 8 roses at 5 cents each; how much did she receive for them?

7. How many pinks has Rose on 8 stems, if there are 9 pinks on each stem?

8. Mary gave to the poor 10 cents each week; how much would she give away in 8 weeks?

9. Write the multiplication table of eights, using the symbols × and =.

WRITTEN EXERCISES.

26	35	57	43	52	54	234	650
8	8	8	8	8	8	8	8
345	654	426	720	432	245	927	258
3	5	8	2	7	8	3	8
334	201	450	327	444	540	633	424
7	8	4	5	6	8	7	8

LESSON XIV.

Dividing for Quotients of Eight.

HOW many times are 3 contained in 24?

Solution.—Three are contained 8 times in 24, because 8 times 3 are 24.

2. How many times are 2 contained in 16? 4 in 32? 3 in 24? 6 in 48? 5 in 40? 7 in 56? 9 in 72?

3. How many times are 6 contained in 24? 12 in 96? 4 in 28? 7 in 49? 8 in 64? 10 in 80? 11 in 88?

DIVISION TABLE.

1 in 8, 8 times
2 in 16, 8 times
3 in 24, 8 times
4 in 32, 8 times
5 in 40, 8 times
6 in 48, 8 times
7 in 56, 8 times
8 in 64, 8 times
9 in 72, 8 times
10 in 80, 8 times
11 in 88, 8 times
12 in 96, 8 times

4. How many caps, at 2 dollars each, can be bought for 16 dollars?

5. How many lead pencils, at 6 cents apiece, can I buy for 48 cents?

6. A farmer sold melons at 5 cents apiece, and received 40 cents; how many melons did he sell?

7. A bookcase contains 56 books, and there are 8 books on a shelf; required the number of shelves?

8. I paid 96 cents for 12 yards of muslin; what was the cost per yard?

9. Write the division table of eights, using the symbols ÷ and =.

WRITTEN EXERCISES.

1)8 2)16 3)24 4)32 5)40 6)48 7)56 8)64 9)72
4)56 3)54 6)72 8)96 5)125 6)756 7)427 8)648
9)360 9)369 7)357 6)3660 4)3248 8)3216 9)4608
2)2468 3)3525 4)7216 8)2744 9)2763 5)5025

Note.—The teacher will show the pupil how to divide when there are remainders.

LESSON XV.

Multiplying by Nine.

IF one yard of silk costs 3 dollars, how many times 3 dollars will 9 yards cost?

2. How many are 9 times 3?

SOLUTION.—9 times 3 are 27, since the sum of nine 3's is 27.

3. How many are 9 times 3? 9 times 1? 9 times 2? 9 times 4? 9 times 5? 9 times 6?

4. How many are 9 times 7? 9 times 8? 9 times 9? 9 times 10? 9 times 11? 9 times 12?

MULTIPLICATION TABLE.

9 times 1 are 9
9 times 2 are 18
9 times 3 are 27
9 times 4 are 36
9 times 5 are 45
9 times 6 are 54

9 times 7 are 63
9 times 8 are 72
9 times 9 are 81
9 times 10 are 90
9 times 11 are 99
9 times 12 are 108

5. If Jennie's doll cost 5 dimes, how much will 9 such dolls cost?

6. How many pages will Sarah read in 9 days, if she reads 7 pages each day?

7. How many pupils are there in 9 classes, if there are 11 pupils in each class?

8. William reads 6 books in a month; how many books, at that rate, will he read in 9 months?

9. Write the multiplication table of nines, using the symbols × and =.

WRITTEN EXERCISES.

31	52	73	644	745	346	947	758	829
9	9	9	9	9	9	9	9	9
424	356	748	926	831	445	820	653	421
2	4	3	5	6	7	8	7	9
244	436	545	346	234	981	706	327	405
9	8	7	9	9	9	9	8	9

LESSON XVI.

Dividing for Quotients of Nine.

HOW many times are 3 contained in 27?

SOLUTION.—Three are contained 9 times in 27 because 9 times 3 are 27.

2. How many times are 2 contained in 18? 4 in 36? 5 in 45? 8 in 72? 10 in 90?

3. How many times are 11 contained in 99? 7 in 56? 12 in 108? 6 in 54? 3 in 27? 7 in 63?

DIVISION TABLE.

1 in 9, 9 times
2 in 18, 9 times
3 in 27, 9 times
4 in 36, 9 times
5 in 45, 9 times
6 in 54, 9 times
7 in 63, 9 times
8 in 72, 9 times
9 in 81, 9 times
10 in 90, 9 times
11 in 99, 9 times
12 in 108, 9 times

4. Mary gave away 36 roses, giving 4 roses to each of her playmates; how many playmates were there?

5. Sixty-three trees are planted in rows with 7 trees in each row; required the number of rows.

6. If 6 sheets of paper make one copy book, how many copy books will 42 sheets make?

7. How many bottles of ink can I get for 90 cents, if I pay 10 cents a bottle?

8. How many weeks are there in 35 days, there being 7 days in one week?

9. Write the division table of nines, using the symbols ÷ and =.

WRITTEN EXERCISES.

3)9 2)18 3)27 4)36 5)45 6)54 7)63 8)72 9)81

3)63 4)72 8)104 9)117 7)105 6)114 5)135 7)651

8)792 9)819 9)8118 8)7264 7)6307 6)3642

3)4272 4)4256 8)4504 9)5481 9)6489 9)10836

LESSON XVII.

Multiplying by Ten.

IF a hen is worth 2 dimes, how many times 2 dimes are 10 hens worth?

2. How many are 10 times 2?

SOLUTION.—Ten times 2 are 20, because the sum of ten 2's is 20.

3. How many are 10 times 3? 10 times 4? 10 times 1? 10 times 5? 10 times 6?

4. How many are 10 times 7? 10 times 8? 10 times 9? 10 times 10? 10 times 11? 10 times 12?

MULTIPLICATION TABLE.

10 times 1 are 10
10 times 2 are 20
10 times 3 are 30
10 times 4 are 40
10 times 5 are 50
10 times 6 are 60
10 times 7 are 70
10 times 8 are 80
10 times 9 are 90
10 times 10 are 100
10 times 11 are 110
10 times 12 are 120

5. If there are 7 days in one week, how many days are there in 10 weeks?

6. Edgar gave 6 marbles to each of his 10 playmates; how many marbles did it take?

7. How many trees are there in 10 rows, if there are 9 trees in each row?

8. A fly has 6 legs and 2 wings; how many legs and how many wings have 10 flies?

9. Write the multiplication table of tens, using the symbols × and =.

WRITTEN EXERCISES.

2	3	4	5	6	7	8	9	10	11	12
10	10	10	10	10	10	10	10	10	10	10

336	768	646	981	460	731	842	342	657
4	5	6	3	2	9	4	8	7

524	937	726	243	901	672	764	426
8	5	7	9	9	9	3	4

LESSON XVIII.

Dividing for Quotients of Ten.

HOW many times are 2 contained in 20?

SOLUTION.—Two are contained 10 times in 20, because 10 times 2 are 20.

2. How many times are 5 contained in 50? 12 in 60? 6 in 36? 7 in 70? 6 in 60? 8 in 72?

3. How many times are 8 contained in 80? 4 in 40? 9 in 90? 12 in 120? 11 in 88? 11 in 110?

DIVISION TABLE.

1 in 10, 10 times
2 in 20, 10 times
3 in 30, 10 times
4 in 40, 10 times
5 in 50, 10 times
6 in 60, 10 times
7 in 70, 10 times
8 in 80, 10 times
9 in 90, 10 times
10 in 100, 10 times
11 in 110, 10 times
12 in 120, 10 times

4. If I pay 50 dollars for sheep, at 5 dollars each, how many sheep will I buy?

5. If 80 bricks are arranged in piles of 8 bricks in a pile, how many piles are there?

6. There are 100 trees in an orchard, and 10 trees in each row; how many rows are there?

7. How long will it take a car to run 90 miles, if it runs 10 miles an hour?

8. Mary is 5 years old, and Jane is 50 years old; how many times Mary's age equals Jane's age?

9. Write the division table of tens, using the symbols ÷ and =.

WRITTEN EXERCISES.

1)10 2)20 3)30 4)40 5)50 6)60 7)70 8)80 9)90 10)100

3)72 5)65 7)84 10)810 6)132 7)910 8)816 10)720

9)738 10)7380 5)7645 6)8406 7)8407 9)8109

8)2464 9)3681 10)4720 4)4048 6)4374 5)2105

NOTE.—The teacher will show the pupil how to divide when there are remainders.

LESSON XIX.

Multiplication and Division with Eleven.

HOW many are 11 times 2?

SOLUTION.—Eleven times 2 are 22, because the sum of eleven 2's is 22.

2. How many are 11 times 1? 11 times 3? 11 times 4? 11 times 5? 11 times 6?

3. How many are 11 times 7? 11 times 8? 11 times 9? 11 times 10? 11 times 11? 11 times 12?

MULTIPLICATION TABLE.

11 times 1 are 11	11 times 7 are 77
11 times 2 are 22	11 times 8 are 88
11 times 3 are 33	11 times 9 are 99
11 times 4 are 44	11 times 10 are 110
11 times 5 are 55	11 times 11 are 121
11 times 6 are 66	11 times 12 are 132

4. How far will a man travel in 11 hours, at the rate of 4 miles an hour?

5. Amos shot 8 pigeons and 11 times as many robins; how many robins did he shoot?

6. How many are 1 in 11? 2 in 22? 3 in 33? 4 in 44? 5 in 55? 6 in 66? 7 in 77? 8 in 88? 9 in 99? 10 in 110? 11 in 121? 12 in 132?

7. Write the division table of elevens, using the symbols ÷ and =.

WRITTEN EXERCISES.

2	3	4	5	6	7	8	9	10	11	12
11	11	11	11	11	11	11	11	11	11	11

34	56	78	234	426	321	789	526	632
11	11	11	11	11	11	11	11	11

354	429	423	836	542	643	741	854
6	8	7	4	6	7	9	7

2)22 3)33 4)44 5)55 6)66 7)77 8)88 9)99 10)110 11)121

4)84 6)96 7)91 8)248 11)264 9)279 4)644

8)728 4)2244 3)6732 5)6485 6)6480 3)6489

LESSON XX.

Multiplication and Division with Twelve.

HOW many are 12 times 2?

SOLUTION.—Twelve times 2 are 24, because the sum of twelve 2's is 24.

2. How many are 12 times 1? 12 times 3? 12 times 4? 12 times 5? 12 times 6?

3. How many are 12 times 7? 12 times 8? 12 times 9? 12 times 10? 12 times 11? 12 times 12?

MULTIPLICATION TABLE.

12 times 1 are 12
12 times 2 are 24
12 times 3 are 36
12 times 4 are 48
12 times 5 are 60
12 times 6 are 72
12 times 7 are 84
12 times 8 are 96
12 times 9 are 108
12 times 10 are 120
12 times 11 are 132
12 times 12 are 144

4. James sold 12 birds for 3 dollars apiece how much did he receive for them?

5. What will 12 dozen eggs cost, at the rate of 10 cents a dozen?

6. How many are 1 in 12? 2 in 24? 3 in 36? 4 in 48? 5 in 60? 6 in 72? 7 in 84? 8 in 96? 10 in 120? 11 in 132? 12 in 144?

7. Fill out the following division table, and recite it:

12 ÷ 1 = ?
24 ÷ 2 = ?
36 ÷ 3 = ?
48 ÷ 4 = ?
60 ÷ 5 = ?
72 ÷ 6 = ?
84 ÷ 7 = ?
96 ÷ 8 = ?
108 ÷ 9 = ?
120 ÷ 10 = ?
132 ÷ 11 = ?
144 ÷ 12 = ?

WRITTEN EXERCISES.

23	42	53	36	41	51	35	46	72	81	93	96
12	12	12	12	12	12	12	12	12	12	12	12

336	349	726	459	648	321	747	135	446
12	4	3	5	6	12	7	12	9

3)48 4)52 7)98 6)252 7)343 9)729 8)512

11)6644 12)7284 9)8172 8)6568 7)5068 12)2808

LESSON XXI.

Adding and Subtracting with Larger Numbers.

HOW many are 12 and 2? 22 and 2? 32 and 2? 42 and 2? 52 and 2? 62 and 2? 72 and 2? 82 and 2?

2. How many are 14 less 2? 24 less 2? 34 less 2? 44 less 2? 54 less 2? 64 less 2? 74 less 2?

3. How many are 2 and 3? 12 and 3? 22 and 3? 32 and 3? 42 and 3? 52 and 3? 62 and 3? 72 and 3? 82 and 3? 92 and 3?

4. How many are 15 less 3? 25 less 3? 35 less 3? 45 less 3? 55 less 3? 65 less 3? 75 less 3?

5. How many are 2 and 4? 22 and 4? 32 and 4? 42 and 4? 52 and 4? 62 and 4? 72 and 4? 82 and 4? 92 and 4?

6. How many are 16 less 4? 26 less 4? 36 less 4? 46 less 4? 56 less 4? 66 less 4? 76 less 4? 86 less 4? 96 less 4?

7. How many are 13 and 5? 23 and 5? 33 and 5? 43 and 5? 53 and 5? 63 and 5? 73 and 5? 83 and 5? 93 and 5?

8. How many are 17 less 5? 27 less 5? 37 less 5? 47 less 5? 57 less 5? 67 less 5? 77 less 5? 87 less 5? 97 less 5?

9. How many are 6 and 6? 16 and 6? 26 and 6? 36 and 6? 46 and 6? 56 and 6? 66 and 6? 76 and 6? 86 and 6?

10. How many are 18 less 6? 28 less 6? 38 less 6? 48 less 6? 58 less 6? 68 less 6? 78 less 6? 88 less 6? 98 less 6?

11. How many are 4 and 8? 14 and 8? 24 and 8? 34 and 8? 44 and 8? 54 and 8? 64 and 8? 74 and 8? 84 and 8?

12. How many are 99 less 8? 89 less 8? 79 less 8? 69 less 8? 59 less 8? 49 less 8? 39 less 8? 29 less 8? 19 less 8?

13. How many are 3 and 13? 4 and 14? 5 and 15? 6 and 16? 7 and 17? 8 and 18?

14. How many are 2 and 22? 3 and 23? 4 and 24? 5 and 25? 6 and 26? 7 and 27?

LESSON XXII.

Exercises on the Fundamental Operations.

A HOUSE has 8 windows on one side and 12 windows on the other side; how many windows on both sides?

2. A farmer had 12 horses in one field and 7 horses in another field; how many had he in both fields?

3. A cooper made 14 buckets, and sold 5 of them; how many buckets then remained?

4. A druggist bought 18 cakes of toilet-soap, and sold 10 cakes of it; how many cakes remained?

5. Milo borrowed 25 cents, and returned 8 of them; how many cents does he still owe?

6. Caroline received 20 problems last week, and solved 15 of them; how many did she miss?

7. How many are $2 + 12$? $2 + 22$? $2 + 32$? $2 + 42$? $2 + 52$? $2 + 62$? $2 + 72$?

8. How many are $3 + 13$? $3 + 23$? $3 + 33$? $3 + 43$? $3 + 53$? $3 + 63$? $3 + 73$? $3 + 83$?

9. How many are $13 - 3$? $23 - 3$? $33 - 3$? $43 - 3$? $53 - 3$? $63 - 3$? $73 - 3$? $83 - 3$?

10. How many are $4 + 14$? $4 + 24$? $4 + 34$? $4 + 44$? $4 + 54$? $4 + 64$? $4 + 74$? $4 + 84$?

11. How many are $18 - 4$? $28 - 4$? $38 - 4$? $48 - 4$? $58 - 4$? $68 - 4$? $78 - 4$? $88 - 4$?

12. How many are $5 + 15$? $5 + 25$? $5 + 35$? $5 + 45$? $5 + 55$? $5 + 65$? $5 + 75$? $5 + 85$?

13. How many are $20 - 5$? $30 - 5$? $40 - 5$? $50 - 5$? $60 - 5$? $70 - 5$? $80 - 5$? $90 - 5$?

14. Copy and write the results in place of (?):

$20 - 5 = ?$ $24 - 6 = ?$ $30 - 10 = ?$
$18 - 6 = ?$ $23 - 9 = ?$ $32 - 11 = ?$
$17 - 8 = ?$ $25 - 8 = ?$ $35 - 12 = ?$

15. Copy and write the results in place of (?):

$5 + 8 - 6 = ?$ $12 - 8 + 2 = ?$ $20 + 6 - 8 = ?$
$7 + 9 - 4 = ?$ $14 - 7 + 3 = ?$ $24 - 12 + 5 = ?$
$8 + 3 - 9 = ?$ $15 + 5 - 9 = ?$ $16 + 15 - 9 = ?$

LESSON XXIII.

Exercises on the Fundamental Operations.

PHILO caught 15 fish and gave John 6 of them; how many did Philo keep?

2. Jacob gave 10 cents for crackers and 6 cents for cheese; what did his lunch cost?

3. Janson walked 18 miles in 2 days, and walked 12 miles the first day; how far the second day?

4. Mary's book contained 20 leaves, and a dog tore out 11 leaves; how many leaves remained?

5. Fanny solved 22 problems, and Alice solved 10 problems; how many did Fanny solve more than Alice?

6. Maria read 23 verses to-day and yesterday, but only 11 to-day; how many did she read yesterday?

7. How many are 6 + 6? 6 + 16? 6 + 26? 6 + 36? 6 + 46? 6 + 56? 6 + 66? 6 + 76?

8. How many are 6 — 6? 16 — 6? 26 — 6? 36 — 6? 46 —6? 56 — 6? 66 — 6? 76 — 6?

9. How many are 7 + 7? 7 + 17? 7 + 27? 7 + 37? 7 + 47? 7 + 57? 7 + 67? 7 + 77?

10. How many are 7 — 7? 16 — 7? 25 — 7? 35 — 7? 45 — 7? 55 — 7? 65 — 7? 75 — 7?

WRITTEN EXERCISES.

Add	456 723 205	543 128 751	607 285 346	480 629 753	652 835 367	461 527 468
Subtract	567 352	760 415	856 583	907 362	785 538	700 253
Multiply	362 5	458 4	708 6	372 8	635 7	872 9
Multiply	867 4	827 5	368 6	845 7	806 8	654 9
Divide	4)368	5)650	6)324	7)287	8)432	9)405
Divide	3)468	4)704	5)745	6)396	7)385	8)464

LESSON XXIV.

Exercises on the Fundamental Operations.

HOW many words will 12 boys spell, if each boy spells 8 words?

2. How many dimes will 11 books cost, if one book costs 10 dimes?

3. There are 110 birds in flocks of 10 birds each; how many flocks are there?

4. There are 134 pupils in a school, and 12 pupils in each class; how many classes are there?

5. Fill out the following exercise on the number 3:

$3 + 0 = ?$ $3 - 0 = ?$ $3 \times 0 = ?$ $3 \div 1 = ?$

$1 + 2 = ?$ $3 - 1 = ?$ $3 \times 1 = ?$ $3 \div 3 = ?$

$1 + 1 + 1 = ?$ $3 - 2 = ?$ $1 \times 3 = ?$ $0 \div 3 = ?$

6. Write a similar exercise on the number 4; thus,

$4 + 0 = ?$ $4 - 0 = ?$ $4 \times 0 = ?$ $4 \div 1 = ?$

$1 + 3 = ?$ $4 - 1 = ?$ $4 \times 1 = ?$ $4 \div 4 = ?$

$2 + 2 = ?$ $4 - 2 = ?$ $2 \times 2 = ?$ $4 \div 2 = ?$

$3 + 1 = ?$ $4 - 3 = ?$ $1 \times 4 = ?$ $0 \div 4 = ?$

NOTE.—The teacher may require the pupils to write similar exercises on all the numbers from 5 to 24.

7. Make a division table from the multiplication table of 2 times; thus,

$2 \div 2 = ?$ $8 \div 2 = ?$ $14 \div 2 = ?$ $20 \div 2 = ?$

$4 \div 2 = ?$ $10 \div 2 = ?$ $16 \div 2 = ?$ $22 \div 2 = ?$

$6 \div 2 = ?$ $12 \div 2 = ?$ $18 \div 2 = ?$ $24 \div 2 = ?$

8. Write, in a similar manner, the division table of 3 times; Of 4 times; Of 5 times; Of 6 times, etc.

9. Name all numbers in combination of two each that make 4; 5; 6; 7; 8; 9; 10; 11; 12.

10. Write the numbers which in combination of three each form the numbers 4; 5; 6; 7, etc., to 20.

11. Write a table of each number from 6 to 24; thus,

$5 + 1 = 6$; $4 + 2 = 6$; $3 + 3 = 6$; $2 + 4 = 6$; $1 + 5 = 6$.

$6 - 1 = 5$; $6 - 2 = 4$; $6 - 3 = 3$; $6 - 4 = 2$; $6 - 1 = 5$.

NOTE.—Require a similar drill in the same numbers with three parts, four parts, etc.; involve also multiplication and division.

LESSON XXVI.

Terms and Principles in Multiplication and Division.

THE teacher will present the following lesson inductively, as suggested on pages 26 and 27.

1. When we find the result of a number taken any number of times, the process is called MULTIPLICATION.

2. The number taken a certain number of times is called the MULTIPLICAND.

3. The number which denotes how many times the multiplicand is taken is called the MULTIPLIER.

4. The result obtained is called the PRODUCT. Each of these three is called a TERM.

5. What is the product of 8 apples multiplied by 4?

6. In this problem which is the *multiplicand,* which the *multiplier,* which the *product?*

7. When we take 8 *apples* 4 times, is the result *apples* or something else? Can the product be anything else than *apples?*

8. The product then is of the same denomination as which term?

9. Can we take 8 apples 4 *peaches* times, or simply 4 times?

10. Is 4 an abstract or a concrete number? What kind of a number then must the multiplier be?

11. When we find how many times one number is contained in another, the process is called DIVISION.

12. The number which contains the other is called the DIVIDEND, the number contained is called the DIVISOR, and the number denoting how many times the divisor is contained is called the QUOTIENT.

13. If we divide 8 apples by 2 apples, is the result apples? If not, what is it?

14. Are 2 *apples* contained in 8 *apples* 4 *peaches* times, or 4 *apples* times, or simply 4 times?

15. What kind of a number is 4, and what kind of a number then must the *quotient* always be?

16. How many times 2 equals 8 *apples?* Are 2 *pears* contained any number of times in 8 *apples?*

SECTION IV.

COMMON FRACTIONS.

INTRODUCTION.

Suggestions to the Teacher.

THE first lessons in fractions should be given in accordance with the following principles:

1. *The first lessons in fractions should be given orally.* No text book is needed in teaching the primary ideas of the subject. The teacher should drill the pupils for several days before taking the subject up in the book.

2. *Mental and written exercises should be combined in the first lessons.* The order is first the *idea*, then the *oral* expression of it, and then the *written* expression of it. As soon as a pupil has an idea of an operation, he should be taught to express it in written characters. The seeing of the operation will help to make it clear to the understanding and to fix it in the memory.

3. *The elements of fractions should be taught by means of visible objects.* The pupil should be led to see the fractional idea and relation in the concrete, before he is required to conceive it abstractly. The objects to be employed are apples, lines or circles on the blackboard, etc. An arithmetical frame with long rods cut in sections, is used in the schools of Sweden, Prussia, etc.

4. *The operations in written fractions should be taught to young pupils mechanically.* They should be drilled upon the operations until they are thoroughly familiar with them, even before they understand fully the reasons for these operations. This is in accordance with the principle that *with young pupils practice should precede theory.*

5. The several things to be taught in fractions are as follows: 1. The idea of each fraction and the expression of it; 2. The fractional parts of numbers; 3. Solving problems requiring the fractional parts of numbers; 4. A few of the simpler cases of reduction. After the learner is familiar with these introductory exercises, he is prepared to take up the subject more thoroughly, and learn to dispose of all the ordinary cases.

6. The simple cases should be solved by *analysis* and *induction.* Special problems should be given for solution and the *methods* be inferred from the analysis of these problems. The *principles* of fractions should be illustrated rather than demonstrated. The pupils should commit the principles and learn to apply them readily.

LESSON I.

One-Half.

IF I divide an apple into *two equal parts*, what is *one* of these parts called? *Ans. One-half.*

2. How many *halves* of an apple in *one* apple?

3. If I divide anything into *two equal parts*, what is each part called? How many *halves* of anything equal the *whole?*

4. What do we understand by *one-half* of anything?

Ans. One-half is one of the two equal parts into which anything may be divided.

5. What is one-half of 6?

SOLUTION.—One-half of 6 is three, since two 3's make 6.

6. What is 1 half of 4? Of 8? Of 10? Of 12?

7. What is 1 half of 16? Of 14? Of 20? Of 18?

8. What is 1 half of 24? Of 22? Of 26? Of 28?

9. If a yard of tape costs 4 cents, what will 1 half of a yard cost?

SOLUTION.—If 1 yard of tape costs 4 cents, 1 half of a yard will cost 1 half of 4 cents, which is 2 cents.

10. Mary had 6 oranges, and gave 1 half of them to her brother; how many did she give away?

11. A farmer sold 1 half of 12 sheep to his neighbor; how many sheep did he sell?

12. Sarah had 14 apples, and gave 1 half of them to Jane; how many apples did Jane receive?

13. William sold 1 half of 20 oranges; how many oranges did he sell?

WRITTEN EXERCISES.

1. *One-half* is written thus, $\frac{1}{2}$; *two-halves* is written $\frac{2}{2}$.

2. What is $\frac{1}{2}$ of 24? $\frac{1}{2}$ of 46? $\frac{1}{2}$ of 84? $\frac{1}{2}$ of 102? $\frac{1}{2}$ of 112?

3. Find $\frac{1}{2}$ of 96; $\frac{1}{2}$ of 284; $\frac{1}{2}$ of 396; $\frac{1}{2}$ of 274; $\frac{1}{2}$ of 652.

4. A farmer raised 680 bushels of apples, and sold $\frac{1}{2}$ of them; how many did he sell?

5. A had 250 dollars, and spent $\frac{1}{2}$ of it; how much did he spend? How much remained?

LESSON II.

One Third.

IF I divide an apple in *three equal parts*, what is *one* of these parts called? *Ans. One-third.*

2. What are *two* parts called? *Three* parts? How many *thirds* in *one* apple?

3. What is *one-third?* *Ans. One-third is one of the three equal parts into which anything is divided.*

4. What is one-third of 6? *Ans. One-third of 6 is 2, since three 2's make 6.*

5. What is 1 third of 9? Of 12? Of 18? Of 15?

6. What is 1 third of 24? Of 30? Of 27? Of 33?

7. Reuben had 18 apples, and gave 1 third of them away; how many did he give away?

SOLUTION.—If Reuben had 18 apples, and gave 1 third of them away, he gave away 1 third of 18 apples, or 6 apples.

8. Ada had 21 plums, and gave 1 third of them to Eddie; how many plums did she give to Eddie?

9. Peter bought 24 marbles, and lost $\frac{1}{3}$ of them in play; how many did he lose?

10. What are two-thirds of 6?

SOLUTION.—One-third of 6 is 2, and two-thirds of 6 are 2 times 2, which are 4. Therefore, 2 thirds of 6 are 4.

11. What are 2 thirds of 9? Of 12? Of 15? Of 18?

12. What are 2 thirds of 24? Of 21? Of 30? Of 36?

13. Anna had 9 oranges, and gave Effie 2 thirds of them; how many did she give to Effie?

14. Laura had 30 peaches, and sold Lizzie 2 thirds of them; how many did Lizzie receive?

WRITTEN EXERCISES.

1. The fractions *one-third*, *two-thirds*, etc., are written thus:

One-third,	***Two-thirds,***	***Three-thirds,***	***Four-thirds.***
$\frac{1}{3}$	$\frac{2}{3}$	$\frac{3}{3}$	$\frac{4}{3}$

2. What is $\frac{1}{3}$ of 45? $\frac{1}{3}$ of 54? $\frac{1}{3}$ of 69? $\frac{1}{3}$ of 75?

3. Find $\frac{2}{3}$ of 60; $\frac{2}{3}$ of 96; $\frac{2}{3}$ of 216? $\frac{2}{3}$ of 234.

4. A man had 150 dollars and spent $\frac{1}{3}$ of it; how much did he spend? How much remained?

5. A farmer had 405 sheep, and sold 2 thirds of them; how many did he sell? How many remained?

6. If 5 horses cost 860 dollars, how many dollars will one horse cost?

LESSON III.

One Fourth.

IF I divide an apple into *four equal parts*, what is one of these parts called?

2. What are 2 parts called? 3 parts? 4 parts?

3. How many fourths of an apple in one apple?

4. *One-fourth is one of the four equal parts into which anything may be divided.*

5. Since 8 divided by 4 is 2, what is 1 fourth of 8?

6. What is 1 fourth of 8?

SOLUTION.—One-fourth of 8 is 2, since four 2's are 8.

7. What is 1 fourth of 12? Of 20? Of 28? Of 36?

8. What is 1 fourth of 16? Of 24? Of 32? Of 44?

9. What will 1 fourth of a barrel of flour cost if one barrel costs 8 dollars?

SOLUTION.—If one barrel of flour costs 8 dollars, 1 fourth of a barrel will cost 1 fourth of 8 dollars, which is 2 dollars.

10. Jacob having 12 pens, sold 1 fourth of them to Johnson; how many did he sell?

11. If Rachel gave her sister 1 fourth of 20 pears, how many pears did her sister receive?

12. Marion lost 1 fourth of 40 quinces; how many quinces did she lose?

13. What are 2 fourths of 12?

SOLUTION.—One-fourth of 12 is 3, and 2 fourths of 12 are 2 times 3, which are 6.

14. What are 2 fourths of 8? Of 24? Of 20? Of 32?

15. What are 3 fourths of 12? Of 20? Of 16? Of 36?

16. What are 5 fourths of 8? Of 24? Of 28? Of 40?

17. Sarah gave her brother 2 fourths of 12 oranges; how many did he receive?

18. Mason's age is 2 fourths of 16 years; required the age of Mason.

19. A boy has 24 cents, and his brother has 3 fourths as many; how many have both?

WRITTEN EXERCISES.

1. The fractions *one-fourth*, *two-fourths*, etc., are written as follows:

One-fourth,	***Two-fourths,***	***Three-fourths,***	***Four-fourths.***
$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$	$\frac{4}{4}$

2. What is $\frac{1}{4}$ of 84? Of 96? Of 104? Of 136?

3. What are $\frac{2}{4}$ of 48? Of 84? Of 132? Of 236?

4. What are $\frac{3}{4}$ of 72? Of 100? Of 204? Of 368?

5. A farmer raised 240 bushels of grapes, and sold $\frac{3}{4}$ of them; how many bushels did he sell?

6. There are 480 grains in one ounce Troy; how many grains in $\frac{3}{4}$ of an ounce Troy?

7. If 6 acres of land are worth 540 dollars, what is one acre worth?

LESSON IV.

One Fifth.

IF we divide an orange into *five equal parts*, what is one of these parts called?

2. What are 2 parts called? 3 parts? 4 parts? 5 parts?

3. How many fifths of an orange in one orange?

4. *One-fifth is one of the five equal parts into which anything may be divided.*

5. What is one-fifth of 10? *Ans. One-fifth of 10 is 2, since five 2's are 10.*

6. What is 1 fifth of 15? Of 25? Of 35? Of 40?

7. What are 2 fifths of 5? Of 30? Of 10? Of 45?

8. What are 3 fifths of 15? Of 20? Of 55? Of 45?

9. What are 4 fifths of 20? Of 30? Of 40? Of 60?

10. Mary had 15 oranges, and Rachel has 1 fifth as many; how many has Rachel?

11. Fanny's age is 30 years, and her sister is 3 fifths as old; how old is her sister?

12. A dog killed 3 fifths of a flock of turkeys, consisting of 25; how many were killed?

13. A cow cost 30 dollars, and a coat cost 4 fifths as much; required the cost of the coat.

14. A watch cost 10 dollars more than 4 fifths of 40 dollars; required its cost.

15. Joseph bought 2 fourths of 40 pears, and sold 10 of them; how many remained?

16. Mary has 1 third of 30 roses, and Sarah has 1 half of 20 roses; how many have they both?

WRITTEN EXERCISES.

1. The fractions *one-fifth*, *two-fifths*, etc., are written as follows:

One-Fifth,	***Two-Fifths,***	***Three-Fifths,***	***Five-Fifths.***
$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{5}{5}$

2. Required the value of the following:

$\frac{1}{5}$ of 75; $\frac{1}{5}$ of 135; $\frac{2}{5}$ of 145; $\frac{2}{5}$ of 230; $\frac{3}{5}$ of 540; $\frac{2}{5}$ of 95; $\frac{3}{5}$ of 560; $\frac{4}{5}$ of 745; $\frac{3}{5}$ of 750; $\frac{4}{5}$ of 965.

3. There are 1760 yards in a mile; how many yards in $\frac{3}{5}$ of a mile? In $\frac{4}{5}$ of a mile?

4. If 8 cows cost a farmer 320 dollars, how much did he pay for each cow?

LESSON V.

One Sixth and One Seventh.

IF you divide an orange into 6 *equal parts*, what is 1 part called? 2 parts? 3 parts? etc.

2. How many sixths in *one?* What is one-sixth of anything?

3. What is 1 sixth of 18? Of 12? Of 24? Of 30?

4. What are 2 sixths of 12? Of 36? Of 42? Of 48?

5. What are 3 sixths of 36? Of 42? Of 60? Of 66?

6. What are 5 sixths of 42? Of 48? Of 60? Of 72?

7. Janson had 30 plums, and gave 2 sixths of them away; how many did he give away?

8. Arthur bought 24 pens, and sold 3 sixths of them; how many did he sell?

9. Peter walked 18 miles and rode 5 sixths as far; how far did he ride?

10. If you divide an orange into 7 *equal* parts, what is 1 of these parts called? 2 parts? 3 parts? etc.

11. How many sevenths in one? What is one-seventh of anything?

12. What is 1 seventh of 14? Of 21? Of 35? Of 42?

13. What are 2 sevenths of 7? Of 28? Of 42? Of 77?

14. What are 3 sevenths of 21? Of 70? Of 49? Of 63?

15. What are 4 sevenths of 28? Of 35? Of 56? Of 70?

16. What are 5 sevenths of 42? Of 63? Of 49? Of 84?

17. A watch was bought for 21 dollars, and sold for 6 sevenths of its cost; for how much was it sold?

18. Jane had 35 roses, and Sarah had 4 sevenths as many as Jane; how many roses had Sarah?

19. Robert walked 14 miles in one day, and 6 sevenths as far the next day; how far did he walk both days?

WRITTEN EXERCISES.

1. *One-sixth* is written $\frac{1}{6}$; 2 *sixths*, $\frac{2}{6}$; 3 *sixths*, $\frac{3}{6}$; 1 *seventh*, $\frac{1}{7}$; 2 *sevenths*, $\frac{2}{7}$, etc.

2. Required the value of the following:

$\frac{1}{6}$ of 84; $\frac{1}{6}$ of 108; $\frac{2}{6}$ of 216; $\frac{3}{6}$ of 570; $\frac{4}{6}$ of 720; $\frac{5}{6}$ of 840; $\frac{1}{7}$ of 98; $\frac{1}{7}$ of 203; $\frac{2}{7}$ of 287; $\frac{3}{7}$ of 679; $\frac{4}{7}$ of 896; $\frac{6}{7}$ of 952.

3. A farmer raised 5034 bushels of oats and sold $\frac{5}{6}$ of the crop; how many bushels did he sell?

4. If a locomotive runs 875 miles in a week, how far did it run in $\frac{6}{7}$ of a week?

LESSON VI.

One Eighth, One Ninth, One Tenth, etc.

AN orange is divided into eight equal parts; what is 1 part called? 2 parts? 3 parts? etc.

2. How many eighths in 1? What is one-eighth of anything?

3. What is 1 eighth of 8? Of 16? Of 32? Of 56?

4. What are 3 eighths of 24? Of 40? Of 64? Of 72?

5. What are 5 eighths of 48? Of 80? Of 88? Of 96?

6. Norris caught 32 fish, and sold 4 eighths of them; how many of them remained?

7. A fish-line is 24 feet long, and the pole is 6 eighths as long; how long is the pole?

8. A ran 48 rods, and B ran 5 eighths as far; how much further did A run than B?

9. If an orange is divided into nine equal parts, what is each part called? 2 parts? 3 parts? etc.

10. How many ninths in one? What is one-ninth of anything?

11. What are 2 ninths of 18? Of 36? Of 54? Of 63?

12. What are 4 ninths of 27? Of 72? Of 45? Of 81?

13. What are 7 ninths of 18? Of 27? Of 90? Of 99?

14. What are 8 ninths of 9? Of 27? Of 72? Of 108?

15. Andrew ran 27 rods, and Amos ran 3 ninths as far; how far did Amos run?

16. If a yard of cloth cost 63 cents, how much will 6 ninths of a yard cost?

17. A man bought 72 sheep, and sold 5 ninths of them; how many did he retain?

18. What is 1 tenth of anything? What is 1 eleventh of anything? What is 1 twelfth of anything?

19. What is 1 tenth of 30? 2 tenths of 40? 3 tenths of 80? 4 tenths of 100?

20. What is 1 eleventh of 44? 3 elevenths of 66? 7 elevenths of 88? 8 elevenths of 99?

21. What is 1 twelfth of 36? 3 twelfths of 84? 5 twelfths of 108? 7 twelfths of 144?

22. A man having 60 cows, sold 5 tenths of them; how many then remained?

23. What will 3 elevenths of 33 yards of cloth cost, at 3 dollars a yard?

WRITTEN EXERCISES.

1. *One-eighth* is written $\frac{1}{8}$; 2 *eighths*, $\frac{2}{8}$; 3 *eighths*, $\frac{3}{8}$; 1 *ninth*, $\frac{1}{9}$; 2 *ninths*, $\frac{2}{9}$, etc.

2. Required the value of the following:

$\frac{1}{8}$ of 88; $\frac{2}{8}$ of 96; $\frac{3}{8}$ of 160; $\frac{4}{8}$ of 176; $\frac{5}{8}$ of 272;
$\frac{1}{9}$ of 99; $\frac{2}{9}$ of 108; $\frac{4}{9}$ of 117; $\frac{5}{9}$ of 126; $\frac{8}{9}$ of 144.

3. *One-tenth* is written $\frac{1}{10}$; 2 *tenths*, $\frac{2}{10}$; *one-eleventh*, $\frac{1}{11}$; 2 *elevenths*, $\frac{2}{11}$; *one-twelfth*, $\frac{1}{12}$; 2 *twelfths*, $\frac{2}{12}$, etc.

4. Find $\frac{1}{10}$ of 480; $\frac{2}{10}$ of 360; $\frac{7}{10}$ of 470; $\frac{1}{11}$ of 660; $\frac{5}{11}$ of 242; $\frac{3}{12}$ of 204; $\frac{11}{12}$ of 300.

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LESSON VII.

Arithmetical Analysis.

IF 3 apples cost 6 cents, how many cents will 4 apples cost?

SOLUTION.—If 3 apples cost 6 cents, 1 apple will cost 1 third of 6 cents, which is 2 cents; and 4 apples will cost 4 times 2 cents, which are 8 cents.

2. How many cents will 5 melons cost, if 4 melons cost 8 cents?

3. How many cents will 6 candies cost, if 4 candies cost 12 cents?

4. If 5 peaches are worth 10 cents, how many cents are 7 peaches worth?

5. How much does a farmer pay for 5 sheep, if he pays 30 dollars for 6 sheep?

6. If 8 pounds of meat cost 48 cents, what will 10 pounds of meat cost?

7. If 7 cents buy 14 apples, how many apples will 8 cents buy?

8. How much must be paid for 12 books, at the rate of 5 books for 50 cents?

9. How far will a man travel in 6 days, if he travels 20 miles in 2 days?

10. How much must be paid for 10 chairs, at the rate of 6 chairs for 42 dollars?

11. If some cattle eat 4 tons of hay in 2 weeks, how many tons will they eat in 6 weeks?

12. If Ella paid 3 dollars for 12 yards of cambric, how many yards could she buy for 8 dollars?

13. How far can William walk in 9 hours, if he walks 20 miles in 5 hours?

WRITTEN EXERCISES.

1. If 3 horses cost 480 dollars, what will 4 horses cost?

SOLUTION.—If 3 horses cost 480 dollars, one horse costs one-third of 480 dollars, which is 160 dollars; and 4 horses will cost 4 times 160 dollars, which are 640 dollars.

$$\begin{array}{r} 3)\underline{480} \\ 160 \\ \underline{4} \\ 640 \end{array}$$

2. If 5 acres of land are bought for 560 dollars, how much would 8 acres cost at the same rate?

3. How much will a farmer pay for 9 cows, if he pays 270 dollars for 6 cows?

4. How many pages may I read in 10 days, if I read 240 pages in 4 days?

5. If 7 times my number of cents equals 224 cents, what will 9 times my number equal?

LESSON VIII.

Arithmetical Analysis.

HOW much will one yard of tape cost, if 1 half of a yard cost 5 cents?

SOLUTION.—If 1 half of a yard of tape costs 5 cents, 2 halves, or one yard, will cost 2 times 5 cents, which are 10 cents.

2. What will one box of soap cost, if 1 third of a box costs 2 dollars?

3. If 1 fourth of a yard of cloth costs 3 dollars, how much will one yard cost?

4. If 1 fifth of a melon is worth 2 cents, what is the whole melon worth?

5. If 1 sixth of the price of a cow is 5 dollars, what is the whole price of the cow?

6. How far can a man walk in one day, if he walks 6 miles in 1 fourth of a day?

7. If 1 half of a barrel of flour costs 3 dollars, what will 2 barrels of flour cost?

8. If 1 fourth of a box of raisins is worth 2 dollars, what cost 3 boxes of raisins?

9. How much will 4 kegs of wine cost, if 1 fifth of a keg is worth 3 dollars?

10. What is the cost of 10 barrels of sugar, at the rate of 4 dollars for 1 third of a barrel?

11. James bought 7 quires of paper at the rate of 4 cents for 1 sixth of a quire; required the cost.

12. What is the value of 9 bushels of potatoes, at the rate of three dimes for 1 third of a bushel?

13. How much will 1 half of 8 tons of hay cost, if 3 tons cost 30 dollars?

14. If 8 yards of cloth cost 16 dollars, what will 3 fourths of 16 yards cost?

15. A watch cost 40 dollars, and 1 fifth of its cost is 1 third of the cost of the chain; what was the cost of the chain?

WRITTEN EXERCISES.

1. If 1 third of the cost of a horse is 45 dollars, what is the cost of the horse?

SOLUTION.—If 1 third of the cost of a horse is 45 dollars, 3 thirds, or the whole cost, is 3 times 45 dollars, which are 135 dollars.

$$\begin{array}{r} 45 \\ \underline{3} \\ 135 \end{array}$$

2. If 1 fourth of a car-load of grain is worth 36 dollars, what is the whole car-load worth?

3. What must I pay for 8 acres of land, if 1 fifth of an acre costs 37 dollars?

4. How much can a man lay up in 3 years, if he saves 125 dollars in ¼ of a year?

5. If ⅕ of an acre of land costs 65 dollars, how much will 6 acres cost?

LESSON IX.

Arithmetical Analysis.

WHAT will one yard of muslin cost, if 2 thirds of a yard of muslin cost 10 cents?

SOLUTION.—If 2 thirds of a yard of muslin cost 10 cents, 1 third of a yard will cost 1 half of 10 cents, which is 5 cents; and 3 thirds, or 1 yard, will cost 3 times 5 cents, which are 15 cents.

2. What will one box of raisins cost, if 2 thirds of a box of raisins cost 4 dollars?

3. How much must I give for one load of hay, if 3 fourths of a load cost 6 dollars?

4. If James can walk 12 miles in 4 fifths of a day, how many miles can he walk in a day?

5. Reuben sold 4 fifths of his hens for 16 dollars; how much, at this rate, would he receive for all?

6. What will 2 pounds of starch cost, if 3 fourths of a pound cost 9 cents?

7. If 4 sixths of a barrel of flour is sold for 4 dollars, how much are 3 barrels worth?

8. How far can a boy walk in 4 days, if he can walk 20 miles in 5 sixths of a day?

9. How much will 6 bushels of apples cost, if 7 eighths of a bushel cost 70 cents?

10. Mary bought 7 pecks of beans, at the rate of 5 sixths of a peck for 10 cents; required the cost.

11. Three-fourths of the number of books on a shelf are 27; how many books are there on the shelf?

12. What must I pay for 6 turkeys, if 2 thirds of the price of a turkey is 8 dimes?

13. What must I pay for 1 half of 6 bushels of peaches, if 3 fourths of a bushel cost 3 dollars?

14. Thomas bought 3 dozen eggs, at the rate of 6 cents for 3 fourths of a dozen; how much did they cost?

15. Four-fifths of Mary's money is 20 dollars; what is her money, and what is one-half of her money?

WRITTEN EXERCISES.

1. What will 1 acre of land cost, if 2 thirds of an acre cost 56 dollars?

SOLUTION.—If 2 thirds of an acre cost 56 dollars, 1 third of an acre costs $\frac{1}{2}$ of 56 dollars, or 28 dollars; and 3 thirds, or 1 acre, cost 3 times 28 dollars, or 84 dollars.

$$\begin{array}{r} 2\underline{)56} \\ 28 \\ 3 \\ \hline 84 \end{array}$$

2. How much will a horse cost, if 3 fourths of the cost is 102 dollars?

3. How much grain does a farmer raise, if 4 fifths of the quantity is 460 bushels?

4. If $\frac{5}{6}$ of the money a man has is 480 dollars, how much money has he?

5. At 126 dollars for $\frac{6}{7}$ of an acre, how much will 6 acres of land cost?

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LESSON X.

Arithmetical Analysis.

MARY is 5 years old, which is 1 third of William's age; required William's age.

SOLUTION.—If 5 years is 1 third of William's age, 3 thirds, or William's age, is 3 times 5 years, which are 15 years.

2. A pen cost 3 cents, which is 1 half the cost of a pencil; required the cost of the pencil.

3. A boy walked 6 miles, which is 1 fourth of the distance he rode; how far did he ride?

4. A sheep cost 5 dollars, which is 1 sixth of the cost of a cow; required the cost of the cow.

5. Fanny had 5 plums, which is 1 third as many as Sallie has; how many plums has Sallie?

6. Moses has 8 cows, and this is 1 fourth of Mason's number; how many cows has Mason?

7. Three is 1 fourth of what number?

SOLUTION.—If 3 is 1 fourth of some number, 4 fourths, or that number, is 4 times 3, which are 12.

8. 4 is 1 half of what number? 5 is 1 third of what number? 6 is 1 fourth of what number?

9. 7 is 1 half of what number? 8 is 1 fifth of what number? 6 is 1 seventh of what number?

10. 9 is 1 third of what number? 10 is 1 fourth of what number?

11. 7 is 1 sixth of what number? 11 is 1 eighth of what number? 5 is 1 tenth of what number? 12 is 1 ninth of what number?

WRITTEN EXERCISES.

1. 24 is $\frac{1}{4}$ of what number? 36 is $\frac{1}{5}$ of what number? 48 is $\frac{1}{3}$ of what number?

2. 56 is $\frac{1}{6}$ of what number? 48 is $\frac{1}{8}$ of what number? 50 is $\frac{1}{9}$ of what number?

3. A farmer owns 75 acres of land, which is $\frac{1}{4}$ as much as his neighbor owns; how much does his neighbor own?

LESSON XI.

Arithmetical Analysis.

FRANK has 10 cents, which is 2 thirds as many as Fanny has; how many has Fanny?

SOLUTION.—If 2 thirds of Fanny's number is 10 cents, 1 third of her number is 1 half of 10 cents, which is 5 cents, and 3 thirds, or Fanny's number, is 3 times 5 cents, which are 15 cents.

2. A pole is 8 feet long, which is 2 thirds of the length of the line; required the length of the line.

3. A boy has 12 chestnuts, which is 3 fourths of what he gave away; how many did he give away?

4. Peter sold a cow for 20 dollars, which is 2 fifths of what an ox cost; required the cost of the ox.

5. Edwin lost 9 marbles, which is 3 fourths of what he had at first; how many had he at first?

6. Ten is 2 thirds of what number?

Solution.—If 2 thirds of some number is 10, 1 third of that number is 1 half of 10, which is 5, and 3 thirds, or the number, are 3 times 5, or 15.

7. 6 is 2 thirds of what number? 8 is 2 fourths of what number?

8. 9 is 3 fourths of what number? 10 is 2 fifths of what number?

9. 12 is 3 fifths of what number? 14 is 2 thirds of what number?

10. 16 is 4 sixths of what number? 18 is 6 sevenths of what number?

11. 24 is 6 eighths of what number? 28 is 7 ninths of what number?

12. 30 is 3 fourths of what number? 35 is 5 sevenths of what number?

13. 40 is 4 sixths of what number? 50 is 5 eighths of what number?

14. A slate cost 14 cents, which is 2 sixths of the cost of an arithmetic; what did the arithmetic cost?

15. Daniel found 20 marbles, which is 2 thirds of Henry's number; how many has Henry?

16. A man sold a cow for 24 dollars, which is 4 fifths of what he paid for her; what did he lose?

WRITTEN EXERCISES.

1. 60 is $\frac{2}{3}$ of what number? 75 is $\frac{3}{4}$ of what number?

2. 84 is $\frac{4}{5}$ of what number? 90 is $\frac{5}{8}$ of what number?

3. A man sold a yoke of oxen for 120 dollars, which is $\frac{4}{5}$ of their cost; what was their cost?

4. A farmer sold 450 bushels of wheat, which is $\frac{5}{6}$ of what he raised; how much did he raise?

5. A man lost in business 5760 dollars, which was $\frac{3}{8}$ of his fortune; what was his fortune?

LESSON XII.

Reducing Numbers to Fractions.

HOW many thirds are there in 2?

Solution.—In one there are 3 thirds, and in 2 there are 2 times 3 thirds, which are 6 thirds. Therefore, etc.

2. How many thirds are there in 4? In 5? In 6?

3. How many halves are there in 3? In 4? In 8?

4. How many fourths are there in 2? In 3? In 5?

5. How many fifths are there in 5? In 7? In 9?

6. How many sixths are there in 1? In 2? In 4? In 5?

7. How many sevenths are there in 1? In 3? In 5? In 6? In 8?

8. How many eighths are there in 1? In 2? In 4? In 7? In 9? In 10?

9. How many ninths are there in 2? In 3? In 4? In 6? In 10? In 8?

10. How many thirds are there in 3 and 2 thirds?

11. How many thirds are there in 4 and 2 thirds?

12. How many fourths in 2 and 3 fourths? In 3 and 2 fourths? In 4 and 3 fourths?

13. How many sixths in 1 and 4 sixths? In 3 and 2 sixths? In 4 and 4 sixths?

14. How many fifths in 3 and 2 fifths? In 2 and 3 fifths? In 5 and 4 fifths?

15. How many eighths in 2 and 5 eighths? In 5 and 7 eighths? In 6 and 3 eighths?

16. How many sevenths in 1 and 2 sevenths? In 2 and 3 sevenths? In 4 and 5 sevenths?

WRITTEN EXERCISES.

1. How many eighths in $17\frac{3}{8}$?

$$\begin{array}{r}17\frac{3}{8}\\ \underline{8}\\ \frac{139}{8}\end{array}$$

Solution.—To reduce $17\frac{3}{8}$ to eighths, we multiply the 17 by 8 and add the 3 to the product, and we have $\frac{139}{8}$.

2. How many fourths in $12\frac{3}{4}$? In $16\frac{1}{4}$? In $25\frac{3}{4}$?

3. How many fifths in $16\frac{3}{5}$? In $18\frac{4}{5}$? In $21\frac{2}{5}$?

4. How many sixths in $15\frac{5}{6}$? In $17\frac{3}{6}$? In $24\frac{1}{6}$?

5. How many sevenths in $13\frac{3}{7}$? In $20\frac{5}{7}$? In $26\frac{6}{7}$?

LESSON XIII.

Reducing Fractions to Numbers.

HOW many whole apples in 6 halves of an apple?

Solution.—In one there are 2 halves, and in 6 halves there are as many *ones* as 2 is contained times in 6, which are 3. Therefore in 6 halves of an apple there are 3 apples.

2. How many whole apples in 4 halves of an apple? In 8 halves of an apple?

3. How many oranges in 6 thirds of an orange? In 9 thirds of an orange?

4. How many lemons in 8 fourths of a lemon? In 12 fourths of a lemon?

5. How many peaches in 10 fifths of a peach? In 20 fifths of a peach?

6. How many pounds in 14 sevenths of a pound? In 28 sevenths of a pound?

7. How many quarts in 18 sixths of a quart? In 24 sixths of a quart?

8. How many dollars in 16 eighths of a dollar? In 32 eighths of a dollar?

9. How many cents in 20 tenths of a cent? In 50 tenths of a cent?

10. If 2 peaches cost 6 fifths of a cent, how many fifths of a cent will 1 peach cost?

11. If 1 peach cost 3 fifths of a cent, how many fifths of a cent will 4 peaches cost?

12. If 2 oranges cost 6 fourths of a cent, how many cents will 4 oranges cost?

13. How many cents will 5 lemons cost, if 3 lemons cost 9 fifths of a cent?

14. What will be the cost of 6 pounds of sugar, if 5 pounds are worth 10 sixths of a dollar?

WRITTEN EXERCISES.

1. How many ones in $\frac{24}{5}$?

Solution.—To reduce $\frac{24}{5}$ to ones, we divide 24 by 5, and have $4\frac{4}{5}$.

$$\begin{array}{r} 5)\underline{24} \\ 4\frac{4}{5} \end{array}$$

2. How many ones in $\frac{34}{6}$? In $\frac{45}{7}$? In $\frac{72}{8}$?

LESSON XII.

Reducing Numbers to Fractions.

HOW many thirds are there in 2?

Solution.—In one there are 3 thirds, and in 2 there are 2 times 3 thirds, which are 6 thirds. Therefore, etc.

2. How many thirds are there in 4? In 5? In 6?

3. How many halves are there in 3? In 4? In 8?

4. How many fourths are there in 2? In 3? In 5?

5. How many fifths are there in 5? In 7? In 9?

6. How many sixths are there in 1? In 2? In 4? In 5?

7. How many sevenths are there in 1? In 3? In 5? In 6? In 8?

8. How many eighths are there in 1? In 2? In 4? In 7? In 9? In 10?

9. How many ninths are there in 2? In 3? In 4? In 6? In 10? In 8?

10. How many thirds are there in 3 and 2 thirds?

11. How many thirds are there in 4 and 2 thirds?

12. How many fourths in 2 and 3 fourths? In 3 and 2 fourths? In 4 and 3 fourths?

13. How many sixths in 1 and 4 sixths? In 3 and 2 sixths? In 4 and 4 sixths?

14. How many fifths in 3 and 2 fifths? In 2 and 3 fifths? In 5 and 4 fifths?

15. How many eighths in 2 and 5 eighths? In 5 and 7 eighths? In 6 and 3 eighths?

16. How many sevenths in 1 and 2 sevenths? In 2 and 3 sevenths? In 4 and 5 sevenths?

WRITTEN EXERCISES.

1. How many eighths in $17\frac{3}{8}$?

Solution.—To reduce $17\frac{3}{8}$ to eighths, we multiply the 17 by 8 and add the 3 to the product, and we have $\frac{139}{8}$.

$$\begin{array}{r}17\frac{3}{8}\\ 8\\ \hline \frac{139}{8}\end{array}$$

2. How many fourths in $12\frac{3}{4}$? In $16\frac{1}{4}$? In $25\frac{3}{4}$?

3. How many fifths in $16\frac{3}{5}$? In $18\frac{4}{5}$? In $21\frac{2}{5}$?

4. How many sixths in $15\frac{5}{6}$? In $17\frac{3}{6}$? In $24\frac{1}{6}$?

5. How many sevenths in $13\frac{3}{7}$? In $20\frac{5}{7}$? In $26\frac{6}{7}$?

SECTION V.

FUNDAMENTAL OPERATIONS.

LESSON I.

NUMERATION AND NOTATION.

THE CHARACTERS used in writing numbers are called *figures.*

2. The METHOD of expressing numbers by figures is as follows:

1. *A figure standing alone expresses* ONES, or UNITS.
2. *A figure in the second place at the left expresses* TENS.
3. *A figure in the third place expresses* HUNDREDS; *in the fourth place,* THOUSANDS; *in the fifth place,* TEN-THOUSANDS, *etc.*

3. The following little table shows the names of the first twelve places:

NUMERATION TABLE.

NAMES.	Hundred-billions.	Ten-billions.	Billions.	Hundred-millions.	Ten-millions.	Millions.	Hundred-thousands.	Ten-thousands.	Thousands.	Hundreds.	Tens.	Units.
	5	5	5	3	5	5	5	7	3	2	6	4
PLACES.	12th,	11th,	10th,	9th,	8th,	7th,	6th,	5th,	4th,	3d,	2d,	1st,
PERIODS.	4th.			3d.			2d.			1st.		

4. The first three places are called *units period.* Thus, the 264 expresses *two hundred and sixty-four* UNITS.

5. The second three places are called *thousands period.* Thus, the 573 expresses *five hundred and seventy-three* THOUSANDS.

6. The third three places are called *millions period.* The fourth three places are called *billions period.*

NOTE.—The teacher will explain this until it is clearly understood. No written explanation can make it as clear to the learner as can the living teacher.

MENTAL EXERCISES.

1. The pupil will give the name of each of the following places:

1. First.
2. Third.
3. Second.
4. Fourth.
5. Sixth.
6. Fifth.
7. Seventh.
8. Eighth.
9. Ninth.

2. The pupil will give the number of the place of each of the following:

1. Units.
2. Tens.
3. Hundreds.
4. Thousands.
5. Millions.
6. Billions.
7. Ten-thousands.
8. Ten-millions.
9. Hundred-thousands.

7. NUMERATION is the art of reading numbers. We can read numbers by the following rule:

RULE.—I. *Begin at the right hand, and separate the numerical expression into periods of three figures each.*

II. *Then begin at the left hand, and read each period as if it stood alone, giving the name of each period except the last.*

NOTE.—The teacher will explain this to the pupils, instead of requiring them to commit and recite it.

WRITTEN EXERCISES.

1. Write and read 4356508.

SOLUTION.—We separate the expression into periods of three figures each. The third period is 4 *millions*, the second period is 356 *thousands*, the first period is 508; and the number is read 4 millions, 356 thousands, five hundred and eight.

OPERATION.
4,356,508

Read the following:

2. 2567
3. 4635
4. 7284
5. 28406
6. 35294
7. 268750
8. 384652
9. 2567534
10. 46785632

8. NOTATION is the art of writing numbers. We can write numbers by the following rule:

RULE.—I. *Begin at the left hand, and write the hundreds, tens, and units of each period in their proper order.*

II. *When there are vacant places fill them with ciphers.*

WRITTEN EXERCISES.

1. Write the number *five thousand three hundred and six.*

	OPERATION.
SOLUTION.—We write the 5 thousands in the 4th place, the 3 hundreds in the third place, a cipher in the 2d place, and the six units in the first place.	5,306

Write the following numbers:

1. One hundred and six.

2. Four hundred and ten.

3. Five hundred and forty.

4. One thousand six hundred and fifty-eight.

5. Six thousand four hundred and eighty-five.

6. Six thousand and eighty-five.

7. Seven thousand and sixty-four.

8. Forty-seven thousand six hundred and fifty.

9. One hundred and fifty thousand and six.

10. One million, four hundred and five thousand, six hundred and eight.

NOTE.—The teacher will drill the pupils in such exercises until they can read and write numbers readily. Do not expect to complete everything at first. Go on with the next subjects, and return to this every few days, or combine it with the following topics.

LESSON II.

ADDITION.

THE finding of the *sum* of two or more numbers is called ADDITION.

2. The symbol + is the sign of addition, and is called *plus.* The symbol = is read *equals.* Thus $4+5=9$ is read "4 plus 5 equals 9."

NOTE.—The symbol $ means dollars. We explain it here in order to use it in some of the following problems.

CASE I.

3. *To add when the sum of no column exceeds nine units of that column.*

1. Find the sum of 24, 32, and 41.

SOLUTION.—We write the numbers so that units are under units, and tens under tens; draw a line beneath, and begin at the right to add. 4 and 2 are 6 and 1 are 7; we write the 7 in units place; 2 and 3 are 5 and 4 are 9; we write the 9 in tens place, and we have 97.

OPERATION.

$$\begin{array}{r}41\\32\\\underline{24}\\97\end{array}$$

WRITTEN EXERCISES.

Find the sum of

2. 30, 23, and 24.
3. 21, 22, and 35.
4. 34, 21, and 43.
5. 121, 202, and 543.
6. 153, 214, and 312.
7. 610, 156, and 213.
8. 432, 234, and 321.
9. 216, 501, and 172.
10. 413, 212, and 164.
11. 731, 146, and 102.
12. 182, 503, and 304.
13. 1632, 4153, and 1202.
14. 1412, 1231, and 4325.
15. 2715, 4130, and 3054.
16. 1212, 31402, 30321, 17032, and 20031.

MENTAL EXERCISES.

1. If I see 7 birds on one tree, and 6 birds on another tree, how many birds do I see?

SOLUTION.—If I see 7 birds on one tree, and 6 birds on another tree, I see 7 birds plus 6 birds, which are 13 birds.

2. I found 9 eggs in one nest, and 12 eggs in another nest; how many eggs did I find in both nests?

3. Mamie has a bouquet of 8 roses, and Susie has one of 10 roses; how many roses are there in both?

4. If there are 13 boys and 12 girls in school, how many scholars are there in the school?

5. I saw 14 crows on a tree, and 13 crows under a tree; how many crows did I see in all?

6. Begin at 2 and add by 2's as far as 24. Begin at 1 and add by 2's as far as 25.

7. Begin at 3 and add by 3's to 30. Begin at 1 and add by 3's to 31. Begin at 2 and add by 3's to 32.

8. What is the value of $7 + 3 + 4$? Of $8 + 4 + 5$? Of $5 + 7 + 6$? Of $5 + 6 + 8$? Of $6 + 7 + 8$? Of $7 + 8 + 9$?

WRITTEN EXERCISES.

1. A man gave his son $405 and his daughter $573; how much did he give to both?

2. William takes 532 steps in going to school, and Henry takes 456 steps; how many steps do both take?

3. A horse cost $215, a pair of oxen $160, and a cow $24; what did they all cost?

4. A farmer raised 3160 bushels of wheat, 507 bushels of oats, and 2322 bushels of corn; how many bushels of grain did he raise?

5. A man saved $2135 one year, $1502 the next year, and $5061 the third year; how much did he save in three years?

CASE II.

4. *To add when the sum of a column exceeds nine units of that column.*

1. What is the sum of 48, 27, 93?

SOLUTION.—We write the numbers with units under units, and tens under tens; draw a line beneath, and begin at the right to add. 8 and 7 are 15 and 3 are 18; we write the 8 and add the 1 to the next column; 1 and 4 are 5, and 2 are 7, and 9 are 16; we write the 16; hence the sum is 168.

OPERATION.

$$\begin{array}{r} 93 \\ 27 \\ 48 \\ \hline 168 \end{array}$$

NOTE.—The teacher can explain the *reason* for "carrying" when the pupil is old enough to understand it.

WRITTEN EXERCISES.

2. Add 35, 42, and 67.
3. Add 28, 43, and 54.
4. Add 36, 75, and 45.
5. Add 29, 32, and 54.
6. Add 56, 73, and 48.
7. Add 65, 39, and 75.
8. Add 135, 372, and 460.
9. Add 346, 542, and 708.
10. Add 209, 843, and 325.
11. Add 725, 634, and 580.
12. Add 576, 305, and 617.
13. Add 813, 794, and 241.

(14)	(15)	(16)	(17)	(18)	(19)
927	745	242	318	224	703
835	312	715	619	846	681
212	764	343	230	715	185
130	123	525	541	204	518

(20)	(21)	(22)	(23)	(24)	(25)
361	712	876	25	2028	5607
204	172	91	386	5634	4073
328	845	127	42	2040	5430
506	819	50	407	4907	785
284	271	123	53	2151	35

(26)	(27)	(28)	(29)	(30)	(31)
4215	2051	5136	1072	5072	7121
7563	3627	1527	3905	1523	2018
3142	4135	380	273	4141	562
2565	2740	215	1512	203	43
3013	3165	51	46	3725	5607

(32)	(33)	(34)	(35)	(36)	(37)
7050	1721	5132	8180	4172	4666
2708	1465	674	309	5136	3333
5632	324	26	5700	56	5406
8305	560	3758	459	130	257
415	78	8103	3651	6915	48

MENTAL EXERCISES.

1. If there are 6 boys on one seat, 7 boys on another seat, and 5 boys on another seat, how many boys are there in all?

SOLUTION.—In all there are 6 boys plus 7 boys, which are 13 boys, plus 5 boys, which are 18 boys. Therefore, etc.

2. If I catch 5 fish one day, 6 the next day, and 7 the next day, how many fish do I catch in the three days?

3. In one nest there are 7 eggs, in another 5 eggs, and in another 8 eggs; how many eggs in the three nests?

4. If I have 10 cents, and my mother gives me 8 cents, and my father gives me 6 cents, how many cents shall I then have?

5. A girl paid 12 cents for a slate, 6 cents for a pencil-holder, and 5 cents for candies; how much did she spend for all?

6. Begin at 4 and add by 4's as far as 32. Begin at 1 and add by 4's as far as 33. Begin at 2 and add by 4's as far as 34. Begin at 3 and add by 4's as far as 35.

7. Begin at 5 and add by 5's as far as 30. Begin at 1 and add by 5's as far as 31. Begin at 2 and add by 5's as far as 32. Begin at 3 and at 4 and add by 5's as far as 33 and 34.

WRITTEN EXERCISES.

1. Mary's doll cost 85 cents, and a little cradle for it cost 135 cents; how much did both cost?

SOLUTION.—If Mary's doll cost 85 cents, and a little cradle cost 135 cents, they both cost the sum of 85 cents and 135 cents, which is 220 cents.

OPERATION.

$$\begin{array}{r} 85 \\ 135 \\ \hline 220 \end{array}$$

2. Willie had 355 cents in his money-box, and his grandmother gave him 187 cents; how many cents had he then?

3. James took 758 steps in going to school, and Jennie took 847 steps; how many steps did they both take?

4. In Fannie's mother's garden there are 38 roses, 47 pinks, and 28 lilies; how many flowers are there in the garden?

5. Sallie spelled 75 words one week, 64 the next week, and 82 the next week; how many words did Sallie spell in the three weeks?

6. Harry's top cost 35 cents, his whip cost 48 cents, his ball 75 cents, and his bat 24 cents; what was the cost of them all?

7. A farmer sold 586 eggs one year, 2308 the next year, and 4765 the following year; how many eggs did he sell in the three years?

8. Sarah wrote thirty-eight words one week, seventy-five the next week, and ninety-six the third week; how many words did she write in all?

9. I had eighty cents in my money-bank; my father put in ninety-five cents and my mother put in eighty-seven cents; how much was then in the bank?

10. A farmer raised three hundred and five bushels of wheat, seven hundred and forty-seven bushels of corn

and eight hundred and seventy-eight bushels of rye; how many bushels of grain did he raise?

LESSON III.

SUBTRACTION.

THE finding of the *difference* of two numbers is called SUBTRACTION.

2. The number we subtract is called the *Subtrahend.* The number we subtract from is called the *Minuend.* The result is called the *Difference* or *Remainder.*

3. The symbol — is the sign of subtraction, and is called *minus.* Thus 8 — 6 = 2 is read "8 minus 6 equals 2."

CASE I.

4. *To subtract when no term of the subtrahend is greater than the corresponding term of the minuend.*

1. Subtract 24 from 58.

SOLUTION.—We write the 24 under the 58, draw a line beneath, and begin at the right to subtract. 4 units from 8 units leave 4 units; 2 tens from 5 tens leave 3 tens. The difference is 34.

OPERATION.

$$\begin{array}{r} 58 \\ \underline{24} \\ 34 \end{array}$$

WRITTEN EXERCISES.

Subtract

2. 374 from 786.
3. 425 from 967.
4. 2107 from 8428.
5. 3056 from 4277.
6. 405 from 607.
7. 328 from 548.
8. 3072 from 7285.
9. 4208 from 6529.

(10)	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**
872	725	857	907	840	876
161	413	654	205	320	345

(16)	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**
8769	4876	8275	8799	8591	5857
3257	2142	3251	2542	7230	1234

(22)	(23)	(24)	(25)	(26)
253786	472589	87695	56728	98785
213123	212423	23542	21306	21342

(27)	(28)	(29)	(30)	(31)
373967	873972	72587	95837	89976
212961	132421	51234	51321	32742

MENTAL EXERCISES.

1. If I had 12 apples, and gave 8 of them away, how many apples remained?

SOLUTION.—If I had 12 apples and gave 8 of them away, there remained 12 apples minus 8 apples, which are 4 apples. Therefore, etc.

2. Susan had 13 pins in a cushion, and took out 7; how many pins remained?

3. There were 16 words given out in the spelling class, and 7 were misspelled; how many were spelled correctly?

4. There were 28 leaves in Ellen's book, and a dog tore out 10 leaves; how many leaves remained in the book?

5. If you cut off 12 feet of a kite-string 23 feet long, how many feet of the string will remain?

6. A boy had 20 marbles, and in playing lost all of them but 5; how many did he lose?

7. Peter picked 21 peaches for his mother, and his brother took 8 of them; how many remained for his mother?

8. There were 25 robins in a cherry-tree, I shot 6, and the rest flew away; how many flew away?

9. Begin at 20 and count backward by 2's to nothing. Begin at 21 and count backward by 2's to 1.

10. Begin at 21 and count backward by 3's to nothing. Begin at 22 and count backward by 3's to 1. Begin at 23 and count backward by 3's to 2.

11. What is the value of 12 — 7? Of 18 — 8? Of 20 — 12? Of 21 — 11? Of 24 — 12? Of 26 — 13? Of 6 + 8 — 7? Of 8 + 9 — 10?

12. What is the value of 8 + 7 — 6? Of 4 + 9 — 5? Of 9 + 4 — 6? Of 8 + 7 — 12? Of 10 + 11 — 12? Of 12 + 11 — 10?

WRITTEN EXERCISES.

1. If there are 48 boys and 36 girls in a school, how many more boys are there in the school than girls?

Solution.—There are as many more boys than girls as the difference between 48 and 36, which is 12. Therefore, etc.

$$\begin{array}{r} 48 \\ \underline{36} \\ 12 \end{array}$$

2. My father had 258 acres of land and sold 36 acres; how many acres of land remained?

3. From four thousand seven hundred and ninety-five subtract two thousand four hundred and forty-three.

4. What is the difference between eight thousand and eighty-eight and five thousand and seventy-four?

5. A man carted 3047 bricks from a pile containing 8797; how many bricks remained?

6. What is the difference between twelve thousand seven hundred and forty-six and five thousand and twenty-five?

7. Mary cried because she couldn't tell how many she must add to 1325 to make 5748; can you tell?

8. Sarah had saved four hundred and seventy-five cents, and spent two hundred and fifty-two cents; how much had she remaining?

9. A farmer raised one thousand eight hundred and fifty-eight bushels of corn, and sold five hundred and thirty-five bushels; how many bushels remained?

CASE II.

5. *To subtract when a term of the subtrahend is greater than the corresponding term of the minuend.*

1. Subtract 28 from 52.

Solution.—We write 28 under 52, draw a line beneath, and begin at the right to subtract. We cannot subtract 8 from 2; so we borrow 1 ten from the 5 tens, leaving 4 tens, and add it to the 2 units, making 12 units; 8

OPERATION.

$$\begin{array}{r} 52 \\ \underline{28} \\ 24 \end{array}$$

units from 12 units leave 4 units; 2 tens from 4 tens leave 2 tens; hence the remainder is 24.

NOTE.—With the youngest pupils it may be merely shown that we add *ten* to the upper term, and then take *one* from the next upper term, or add *one* to the next lower term, without explaining the reason.

WRITTEN EXERCISES.

(2)	(3)	(4)	(5)	(6)	(7)
63	42	54	51	73	65
25	27	26	24	36	28
(8)	(9)	(10)	(11)	(12)	(13)
83	86	77	82	58	75
27	38	49	28	29	27
(14)	(15)	(16)	(17)	(18)	(19)
87	85	76	90	52	63
39	18	67	28	25	36
(20)	(21)	(22)	(23)	(24)	(25)
342	763	854	981	350	736
218	428	136	245	246	428
(26)	(27)	(28)	(29)	(30)	(31)
463	734	528	742	585	482
146	382	293	391	129	127
(32)	(33)	(34)	(35)	(36)	(37)
425	624	735	824	721	456
281	251	143	136	258	183
(38)	(39)	(40)	(41)	(42)	(43)
567	724	812	713	812	732
382	258	365	298	481	458
(44)	(45)	(46)	(47)	(48)	(49)
721	405	713	854	302	620
253	283	265	689	135	154
(50)	(51)	(52)	(53)	(54)	(55)
4236	6874	6528	8257	4167	6458
1218	1236	3184	1821	3725	1823

(56)	(57)	(58)	(59)	(60)	(61)
41365	71624	82571	92051	85601	40701
28134	29131	47138	60423	76543	20630

(62)	(63)	(64)	(65)	(66)	(67)
45060	62500	47000	28000	50000	100000
12345	13287	12345	12379	14625	1

MENTAL EXERCISES.

1. If there are 20 crows on a tree, and 12 fly away, how many crows are left?

2. A hunter saw 22 rabbits, and shot 8 of them; how many escaped?

3. Eva culled 18 roses, and gave Floy 12 of them; how many did Eva retain?

4. A boy had 6 apples, and picked 8 more, and then gave his brother 10 apples; how many apples had he then?

5. A boy had 10 cents, and found 12 cents, and then spent 11 cents; how many cents had he then?

6. Harry had 20 peaches, gave his sister 8 of them, and ate 6; how many peaches had he then?

7. Begin at 24 and count backward by 4's to naught; begin at 25 and count backward by 4's to 1; begin at 26 and count backward by 4's to 2.

8. Begin at 30 and count backward by 5's to naught; from 31 to 1; from 32 to 2; from 33 to 3; from 34 to 4.

9. What is the value of 6 + 3 — 4? Of 7 + 4 — 5? Of 8 + 5 — 7? Of 5 + 12 — 8? Of 7 + 9 — 6?

10. What is the value of 7 — 4 + 3? Of 8 — 5 + 4? Of 9 — 2 + 7? Of 12 — 8 + 10? Of 20 — 8 + 10? Of 8 + 12 — 6?

WRITTEN EXERCISES.

1. A drover bought 235 horses, and sold 162 of them; how many horses remained unsold?

SOLUTION.—If a drover bought 235 horses, and sold 162 of them, there remained the difference between 235 horses and 162 horses which we find by subtracting is 73 horses.

OPERATION
235
162
73

2. My brother had 245 little chickens, and some minks killed 58 of them; how many chickens remained?

3. Mary went a-nutting and gathered 150 chestnuts, and gave her little brother 75 of them; how many had she then?

4. My kite was 438 feet up in the air, and fell 174 feet; how high was it then?

5. Father's new house cost 5750 dollars, and he sold it for 585 dollars less than it cost; how much did he receive for it?

6. Emma's brother teased her because she couldn't tell how many to add to 346 to make 500; can you tell?

7. One morning in going to school I took 672 steps; how many more should I have to take to make 1000?

8. A boy went to a store and bought a knife for 75 cents, and gave the storekeeper a dollar bill (100 cents) to pay for it; how much change did he receive?

9. Sarah bought a work-box for 275 cents, and gave the storekeeper a 5-dollar bill (500 cents) to pay for it; how much change should she receive?

LESSON IV.

MULTIPLICATION.

THE finding of the *product* of two numbers is called MULTIPLICATION.

2. The number we multiply is called the *Multiplicand.* The number we multiply by is called the *Multiplier.* The result is called the *Product.*

3. The symbol × is the sign of multiplication, and is read *multiplied by*, or *times.* Thus, $8 \times 4 = 32$, is read "8 multiplied by 4 equals 32."

CASE I.

4. *To multiply when the multiplier does not exceed twelve.*

1. Multiply 682 by 3.

OPERATION.

$$\begin{array}{r} 682 \\ \underline{3} \\ 2046 \end{array}$$

SOLUTION.—3 times 2 are 6; we write the 6 under the 2; 3 times 8 are 24; we write the 4 under the 8 and add the 2 to the next product; 3 times 6 are 18 and 2 are 20; we write the 20: the product is 2046.

NOTE.—The teacher may explain the reason for "carrying," and also have the pupils explain when they are old enough to do so.

WRITTEN EXERCISES.

(2) 54 3	(3) 76 2	(4) 43 4	(5) 56 5	(6) 86 3	(7) 72 7
(8) 85 2	(9) 76 3	(10) 94 5	(11) 38 7	(12) 60 9	(13) 48 10
(14) 50 11	(15) 72 9	(16) 86 8	(17) 80 12	(18) 74 12	(19) 90 12
(20) 234 3	(21) 436 4	(22) 573 5	(23) 682 6	(24) 904 7	(25) 805 8
(26) 728 6	(27) 835 7	(28) 908 9	(29) 736 9	(30) 637 7	(31) 798 5
(32) 970 8	(33) 708 9	(34) 426 11	(35) 654 10	(36) 208 12	(37) 456 12

MENTAL EXERCISES.

1. At 5 dollars a day, how much will a man earn in 6 days?

SOLUTION.—If a man earns 5 dollars in 1 day, in 6 days he will earn 6 times 5 dollars, or 30 dollars. Therefore, etc.

2. What will 7 yards of cloth cost, at 3 dollars a yard?

3. What will 5 pairs of boots cost, at 8 dollars a pair?

4. If there are 10 trees in one row, how many trees are there in 8 rows?

5. If a boy works 11 examples each day, how many examples will he work in 5 days?

6. There are 12 inches in one foot; how many inches are there in 10 feet?

7. There are 7 days in one week; how many days are there in 12 weeks?

8. If John spends 11 cents a week, how much will he spend in 10 weeks?

9. A newsboy earns 12 cents a day; how much will he earn in 11 days?

10. If a ship sails 12 miles an hour, how far will it sail in 12 hours?

WRITTEN EXERCISES.

1. If one yard of muslin costs 25 cents, how much will 7 yards cost?

Solution.—If one yard of muslin costs 25 cents, 7 yards will cost 7 times 25 cents, which are 175 cents

OPERATION.

$$\begin{array}{r}25\\ 7\\ \hline 175\end{array}$$

2. If a boy writes 28 words in a day, how many words will he write in 5 days?

3. If a train of cars runs 32 miles an hour, how far will it run in 6 hours?

4. How many marbles will 8 boys have, if each boy has 15 marbles?

5. If Mary can count 75 a minute, how many can she count in 10 minutes?

6. If there are 36 printed lines on the page of a book, how many printed lines are there in 11 such pages?

7. How much must a man pay for 9 loads of hay, worth 24 dollars a load?

8. There are 5280 feet in a mile; how many feet are there in 12 miles?

CASE II.

5. *To multiply when the multiplier is greater than twelve.*

1. Multiply 65 by 36.

SOLUTION.—6 times 5 are 30; we write the 0 and carry the 3 to the next product: 6 times 6 are 36, and 3 are 39; we write the 39; 3 times 5 are 15; we write the 5 under the 3 and carry the 1 to the next product: 3 times 6 are 18, and 1 are 19; we write the 19: adding, we have 2340.

OPERATION.

$$\begin{array}{r} 65 \\ \underline{36} \\ 390 \\ \underline{195} \\ 2340 \end{array}$$

NOTE.—Teach the pupil how to do the work first; when he is old enough show him the reason for the method.

WRITTEN EXERCISES.

(2)	(3)	(4)	(5)	(6)	(7)
35	46	56	65	75	60
23	24	32	34	45	37
(8)	(9)	(10)	(11)	(12)	(13)
76	43	64	38	85	78
42	38	75	43	76	67
(14)	(15)	(16)	(17)	(18)	(19)
345	463	547	708	825	756
23	43	35	46	64	63
(20)	(21)	(22)	(23)	(24)	(25)
725	817	725	809	728	560
45	65	74	36	67	87
(26)	(27)	(28)	(29)	(30)	(31)
2356	4216	2057	3508	7069	4185
35	43	54	63	37	64
(32)	(33)	(34)	(35)	(36)	(37)
345	372	2184	4725	2057	3608
123	345	416	326	354	436

MENTAL EXERCISES.

1. How many are 10 times 2? 20 times 2? 30 times 3? 40 times 4? 50 times 5?

2. What two numbers multiplied together make 12? 18? 20? 24? 36? 40? 42? 48? 50? 60? 64?

3. How many words will 12 boys spell, if each boy spells 11 words?

4. In one dime there are 10 cents; how many cents are there in 11 dimes?

5. If a man builds 9 rods of wall in a day, how many rods will he build in 12 days?

6. If 12 units make a dozen, how many units are there in 12 dozen?

7. How much more is 12 times 3, than 11 times 2, increased by 3?

8. How many are 2 times 6, plus 6? 3 times 4, plus 4? 4 times 5, plus 5? 6 times 7, plus 7?

9. How many are 2 times 3, plus 4? 3 times 4, plus 5? 4 times 5, plus 6? 5 times 6, plus 7?

WRITTEN EXERCISES.

1. If a boat sails 126 miles a day, how far will it sail in 25 days?

SOLUTION.—If a boat sails 126 miles in one day, in 25 days it will sail 25 times 126 miles, which are 3150 miles.

OPERATION.

$$\begin{array}{r} 126 \\ 25 \\ \hline 630 \\ 252 \\ \hline 3150 \end{array}$$

2. If a locomotive runs 75 miles a day, how far will it run in 14 days?

3. A man bought a farm containing 24 acres, for 250 dollars an acre; how much did it cost?

4. How many trees in a peach orchard, if there are 22 rows of trees, and 46 trees in each row?

5. If a farmer raises 85 bushels of wheat on 1 acre, how many bushels can he raise on 45 acres?

6. A cattle-dealer bought 125 horses, at the rate of 150 dollars apiece; how much did they cost him?

7. There are 5760 grains in one pound Troy; how many grains in 245 pounds Troy?

CASE III.

6. *To multiply when one or both terms contain ciphers.*

1. Multiply 537 by 204.

OPERATION.

$$\begin{array}{r} 537 \\ 204 \\ \hline 2148 \\ 1074 \\ \hline 109548 \end{array}$$

Suggestion.—We first multiply by 4, obtaining 2148; we then pass over the naught and multiply by 2, placing the right-hand figure of the product directly under the 2. Adding, we have 109548.

WRITTEN EXERCISES.

Multiply

2. 367 by 305.
3. 528 by 403.
4. 709 by 406.
5. 596 by 307.
6. 854 by 508.
7. 4325 by 3004.

Multiply

8. 2306 by 2005.
9. 5762 by 4006.
10. 3857 by 6054.
11. 7205 by 3506.
12. 8096 by 4008.
13. 7084 by 5007.

14. Multiply 4600 by 340.

OPERATION.

$$\begin{array}{r} 4600 \\ 340 \\ \hline 184 \\ 138 \\ \hline 1564000 \end{array}$$

Suggestion.—We first multiply 46 by 34, and obtain the product 1564; we then annex the three ciphers to this product, and we have 1564000.

Multiply

15. 4500 by 240.
16. 3600 by 650.
17. 7200 by 380.
18. 8500 by 4200.
19. 6510 by 7300.

Multiply

20. 4700 by 3500.
21. 3060 by 2050.
22. 7000 by 3050.
23. 7080 by 8000.
24. 30600 by 50700.

◆

LESSON V.

Division.

THE finding of the *quotient* of two numbers is called DIVISION.

2. The number we divide is called the *Dividend.* The number we divide by is called the *Divisor.* The result is called the *Quotient.*

3. The symbol ÷ is the sign of division, and is read *divided by.* Thus, $8 \div 4 = 2$ is read "8 divided by 4 equals 2."

CASE I.

4. *To divide by the method of Short Division.*

1. Divide 324 by 6.

SOLUTION.—6 is contained in 32, 5 times and 2 remaining; we write the 5 under 32; 6 is contained in 24, 4 times; we write the 4 under the 4. The quotient is 54.

OPERATION.

6)324
54

NOTE.—1. The teacher may explain the reason for carrying the remainder to the next term, and have the pupils explain it when they are able to do so.

2. A final remainder may be set off by itself, at the right of the quotient.

WRITTEN EXERCISES.

(2) 2)328	(3) 2)573	(4) 2)756	(5) 3)450	(6) 3)524	(7) 3)678
(8) 3)535	(9) 3)795	(10) 3)468	(11) 4)852	(12) 4)704	(13) 4)535
(14) 5)651	(15) 5)848	(16) 5)780	(17) 5)875	(18) 5)735	(19) 5)944
(20) 6)858	(21) 6)785	(22) 6)659	(23) 6)853	(24) 6)786	(25) 6)6854
(26) 7)854	(27) 7)952	(28) 7)998	(29) 7)784	(30) 7)847	(31) 7)9807
(32) 8)433	(33) 8)447	(34) 8)736	(35) 8)4568	(36) 8)5672	(37) 8)6465
(38) 9)702	(39) 9)585	(40) 9)850	(41) 9)3672	(42) 9)4624	(43) 9)7264

MENTAL EXERCISES.

1. James sold 9 birds at 3 dollars each; how much did he receive for them?

2. Fifty dollars was paid for sheep, at the rate of 5 dollars apiece; how many sheep did it buy?

3. How many trees are there in 10 rows, if there are 12 trees in each row?

4. There are 120 trees in an orchard, and 10 trees in each row; what is the number of rows?

5. A fly has 6 legs and 2 wings; how many legs and wings have 12 flies?

6. If 80 books are arranged in piles of 8 books each; how many piles will there be?

7. Read the proper numbers in place of (?).

$24 + 8 = ?$ $36 + 10 = ?$ $48 + 6 = ?$

$14 - 8 = ?$ $36 - 10 = ?$ $48 - 6 = ?$

$3 \times 8 = ?$ $9 \times 4 = ?$ $12 \times 4 = ?$

$24 \div 8 = ?$ $36 \div 9 = ?$ $48 \div 4 = ?$

WRITTEN EXERCISES.

1. How long will it take a steamboat to sail 256 miles, at the rate of 8 miles an hour?

OPERATION.
8)256
32

SOLUTION.—It will take as many hours as 8 is contained times in 256, which are 32.

2. How many barrels of coal oil will 576 dollars buy, at the rate of 8 dollars a barrel?

3. How many yards of cloth can a tailor buy for 456 dollars, at the rate of 4 dollars a yard?

4. How many pigs can a farmer buy for 238 dollars, at the rate of 7 dollars apiece?

5. How long would it take a boy to walk 476 miles, at the rate of 4 miles an hour?

6. If a boy writes 5 words a minute, how many minutes would it take him to write 465 words?

7. There are 7 days in one week; how many days are there in 560 weeks?

8. There are 12 inches in one foot; how many feet are there in 1728 inches?

CASE II.

5. *To divide by the method of Long Division when the divisor is small.*

1. Divide 744 by 3.

OPERATION.

3)744(248
6
14
12
24
24

SOLUTION.—3 is contained in 7, 2 times; 2 times 3 are 6; 6 from 7 leaves 1; bring down the 4, and we have 14; 3 is contained in 14, 4 times; 4 times 3 are 12; 12 from 14 leaves 2; bring down the 4, and we have 24; 3 is contained in 24, 8 times; 8 times 3 are 24; subtracting, nothing remains. The quotient is 248.

NOTE.—When pupils are sufficiently advanced the reason for the method may be explained. What they need to know first is the method.

WRITTEN EXERCISES.

(2) 2)36(18 2 16 16	**(3)** 3)75(25 6 15 15	**(4)** 4)104(26 8 24 24	**(5)** 5)125(25 10 25 25	**(6)** 6)156(26 12 36 36
(7) 4)96(	**(8)** 5)95(	**(9)** 6)144(	**(10)** 7)168(	**(11)** 8)192(
(12) 3)567(	**(13)** 3)462(	**(14)** 4)576(	**(15)** 4)764(	**(16)** 5)860(
(17) 5)975(	**(18)** 5)1070(	**(19)** 6)936(	**(20)** 6)876(	**(21)** 7)784(
(22) 7)826(	**(23)** 7)595(	**(24)** 7)1043(	**(25)** 8)952(	**(26)** 8)1224(
(27) 8)1376(	**(28)** 8)1792(	**(29)** 9)1035(	**(30)** 9)1242(	**(31)** 9)2043(
(32) 10)2560(	**(33)** 10)3640(	**(34)** 11)2343(	**(35)** 12)2784(	**(36)** 12)6540(

CASE II.

6. *To divide by the method of Long Division when the divisor exceeds twelve.*

1. Divide 455 by 13.

OPERATION.

13)455(35
39
65
65

SOLUTION.—13 is contained in 45, 3 times; 3 times 13 are 39; 39 subtracted from 45 leaves 6; bringing down the 5 we have 65; 13 is contained in 65, 5 times; 5 times 13 are 65; subtracting, nothing remains. The quotient is 35.

NOTES.—1. The teacher will call the pupil's attention to the fact that there are four operations: 1st, *divide;* 2d, *multiply;* 3d, *subtract;* 4th, *bring down.*

2. If, when we multiply, the product is greater than the partial dividend, the quotient term is too large, and must be diminished.

3. When a remainder is equal to or greater than the divisor, the quotient term is too small, and must be increased.

4. A final remainder may be set off by itself, or it may be written over the divisor and annexed to the quotient.

5. Some teachers have the pupils form a table of the products of the divisor multiplied by each of the first nine numbers, before beginning to divide; but it is of doubtful propriety.

Divide

2. 353 by 11.
3. 756 by 12.
4. 364 by 13.
5. 476 by 14.
6. 765 by 15.
7. 864 by 16.
8. 792 by 17.
9. 514 by 18.
10. 684 by 19.
11. 760 by 20.
12. 3780 by 21.
13. 2622 by 23.
14. 5760 by 24.
15. 4925 by 25.
16. 5460 by 26.
17. 7317 by 27.
18. 5941 by 29.
19. 6330 by 33.
20. 8670 by 34.
21. 5184 by 36.
22. 4368 by 42.
23. 8568 by 56.

NOTE.—The teacher will explain how to proceed when there are 0's in the quotient.

MENTAL EXERCISES.

1. How many settees will seat 80 boys, if there are 10 boys on each settee?

2. A boy has 84 marbles; how many groups of 12 marbles can he make out of them?

3. How many are 12 plus 6, divided by 6? 25 plus 5, divided by 5? 40 plus 8, divided by 8? 42 plus 7, divided by 7?

4. How many are 16 and 4, divided by 4? 18 and 6, divided by 6? 35 and 5, divided by 5? 48 and 8, divided by 8?

5. How many are 40 minus 4, divided by 4? 50 minus 5, divided by 5? 60 minus 6, divided by 6? 77 minus 7, divided by 7?

6. How many are 6 times 4, divided by 4? 5 times 8, divided by 8? 6 times 8, divided by 4? 9 times 8, divided by 6?

WRITTEN EXERCISES.

1. How many cows can a farmer buy for 1560 dollars, at 24 dollars apiece?

Solution.—He can buy as many cows as $24 is contained times in $1560, which are 65.

OPERATION.
24)1560(65

2. At 14 dollars a ton, how many tons of hay can you buy for 98 dollars?

3. In one pound there are 16 ounces; how many pounds are there in 192 ounces?

4. In one bushel there are 32 quarts; how many bushels are there in 384 quarts?

5. If a train of cars run 36 miles an hour, how long will it take to run 720 miles?

6. The diameter of the earth is nearly 8000 miles; how long would it take a boy to walk this distance, if he walked 32 miles a day?

CASE IV.

7. *To divide when the divisor is larger than in the previous examples.*

WRITTEN EXERCISES.

Divide

1. 1960 by 56.
2. 2944 by 64.
3. 3240 by 72.
4. 5092 by 76.
5. 7055 by 83.
6. 26274 by 87.
7. 37674 by 91.
8. 47785 by 95.
9. 26814 by 123.
10. 49500 by 132.
11. 71288 by 142.
12. 37884 by 154.
13. 4125 by 165.
14. 14742 by 234.
15. 42900 by 325.
16. 166170 by 382.
17. 149454 by 437.
18. 267168 by 528.
19. 293208 by 643.
20. 230776 by 728.
21. 439530 by 805.
22. 724284 by 1023.
23. 1490616 by 1236.
24. 4218916 by 2054.

25. The distance around the world is nearly 25000 miles; how long would it take to sail around it, if the ship sailed 125 miles a day?

CASE V.

8. *To divide when there are ciphers on the right of the divisor.*

1. Divide 2786 by 500.

Solution.—We cut off the two ciphers of 500, and the two terms 86, and divide 27 by 5; we have a quotient of 5 and 2 remaining; we write the 2 and annex the 86 to it, and have 286 for the entire remainder.

OPERATION.

$$5,00\overline{)27|86}$$

5-286

or $5\frac{286}{500}$

Note.—When the divisor, with ciphers cut off, is greater than 12, we divide by the method of long division.

Divide
2. 146 by 50.
3. 286 by 60.
4. 578 by 70.
5. 840 by 80.
6. 1050 by 400.
7. 5672 by 600.
8. 8790 by 700.
9. 12357 by 800.

Divide
10. 5234 by 150.
11. 7328 by 160.
12. 3759 by 220.
13. 48756 by 240.
14. 28732 by 2500.
15. 43256 by 3200.
16. 64530 by 4500.
17. 310240 by 12200.

PRACTICAL PROBLEMS.

1. There are 16 ounces in one pound; how many pounds in 3584 ounces?

2. In one bushel there are 32 quarts; how many bushels in 7840 quarts?

3. A man gave 1875 dollars for cows worth 25 dollars each; how many did he buy?

4. A horse-dealer received $19,500 for a lot of horses, sold at $150 each; how many horses did he sell?

SECTION VI.

DENOMINATE NUMBERS.

INTRODUCTION.

Suggestions to the Teacher.

IN teaching Denominate Numbers, the teacher should have the *actual measures* to illustrate the subject. Every school should be supplied with them; when they are not in school, the teacher can procure them at a trifling expense. In some books we find *pictures* of the measures; but the *measures themselves* are so much better than their *pictures*, to give the true idea, that we have omitted pictures in this work.

MONEY.—Under the title of Money, show the pupil the *cent*, *dollar*, *half-dollar*, *quarter-dollar*, etc. Have also if possible a specimen of the English *penny*, the *franc*, the *reichsmark*, etc.

WEIGHT.—The pupils should be shown the different weights,—the *pennyweight*, the *ounce*, the *pound* Troy; also the *ounce* and *pound* Avoirdupois. Have them notice these weights in the store, etc.

LENGTH.—Give them definite ideas of all the measures of Length. Mark on the board the *inch*, the *foot*, the *yard;* have a *yard-stick* divided into *feet* and *inches;* have the length of a *rod* marked on the wall or the floor: show them how far a *mile* is, a *half mile*, etc.

SURFACE.—Mark on the board a *square inch*, *square foot*, *square yard*, etc.; measure out-doors a *square rod;* show them the size of an *acre;* give them the number of acres in some field, etc.

VOLUME.—Show them a *cubic inch*, *cubic foot;* draw them on the board, and also a *cubic yard;* make a model of a *cord of wood* out of *little sticks* 4 inches long, and then show them a *cord foot.*

LIQUID MEASURE.—Have tin measures of a *gill*, a *pint*, a *quart*, and a *gallon*. Show them barrels and hogsheads at a store.

DRY MEASURE.—Have measures of a *pint* and *quart*, and have them call at the grocer's or some other store and look at a *peck* and a *bushel* measure.

TIME AND CIRCULAR MEASURES.—Time will be very readily understood, and needs no special explanation. In Circular Measure draw a circle, divide it into *quadrants*, *degrees*, and *minutes*, etc. Show that these are *parts* of the circumference, and that they differ in size in different circles, etc.

A drill of this kind under measures will give pupils definite ideas of what they are committing, and will make these tables interesting and thus easily retained. They will be no longer a list of abstract names, as they were at first to many of us, but actual things with definite meanings.

LESSON I.

Measures of Money.

A DENOMINATE NUMBER is a concrete number in which the unit is a *measure;* as 4 *feet*, 5 *pounds.*

2. A MEASURE is a unit by which quantity of magnitude is expressed in numbers; as *yard*, *pound*, etc.

3. Denominate numbers are of eight kinds: Value, Weight, Length, Surface, Volume, Capacity, Time, and Angles or Arcs.

UNITED STATES MONEY.

4. MONEY is the measure of the value of things. It is of two kinds, *coin* and *paper money.*

5. The legal money of the United States is called *United States Money.*

TABLE.

10 mills (*m.*)	equal	1 cent,	*ct.*
10 cents	"	1 dime,	*d.*
10 dimes	"	1 dollar,	$.
10 dollars	"	1 eagle,	*E.*

100 cents = 1 dollar; 25 cents = $\frac{1}{4}$ dollar; 20 cents = $\frac{1}{5}$ dollar;
50 cents = $\frac{1}{2}$ dollar; 75 cents = $\frac{3}{4}$ dollar; $12\frac{1}{2}$ cents = $\frac{1}{8}$ dollar.

MENTAL EXERCISES.

1. If there are 10 cents in one dime, how many cents are there in 2 dimes? In 3 dimes?

2. How many mills in 5 cents? In 6 cents? In 8 cents? In 12 cents?

3. How many cents in 3 dimes? In 7 dimes? In 2 dollars? In 5 dollars?

4. How many dimes in 40 cents?

SOLUTION.—In 10 cents there is 1 dime, and in 40 cents there are as many dimes as 10 is contained times in 40, which are 4. Therefore, etc.

5. How many dimes in 60 cents? In 70 cents? In 90 cents?

6. How many dollars in 50 dimes? In 70 dimes? In 100 cents? In 500 cents?

7. How many eagles in 30 dollars? In 50 dollars? In 80 dollars? In 200 dimes?

WRITTEN EXERCISES.

6. Eagles and dollars are read as a number of dollars. Dimes and cents are read as a number of cents.

7. The dollar is indicated by the symbol $. Dollars and cents are separated by a point. Thus, $36.45 means 36 dollars and 45 cents.

NOTE.—When the cents are less than ten, we put a cipher between the point and the number of cents.

1. Write and read $28.75.

SOLUTION.—This is read 28 dollars and 75 cents.

2. $12.50.
3 $14.65.
4. $35.25.
5. $40.50.
6. $65.62½.
7. $75.37½.
8. $85.06¼.
9. 136.08\frac{1}{12}$.
10. $576.375.

11. Write seven dollars and thirty-five cents.

12. Write twenty-four dollars and forty-seven cents.

13. Write 284 dollars and 75 cents.

14. Write 375 dollars, 6 cents, and 5 mills.

ENGLISH, OR STERLING MONEY.

8. ENGLISH, or STERLING MONEY, is the legal currency of England.

TABLE.

4 farthings (*far.*)	equal	1 penny, ...	*d.*
12 pence . . .	"	1 shilling, ...	*s.*
20 shillings . .	"	1 pound or sovereign,	£.
21 shillings . .	"	1 guinea, ...	*G.*

NOTE.—The Pound or Sovereign is worth $4.8665. A *Florin* is worth 2 shillings, and a *Crown* is worth 5 shillings.

MENTAL EXERCISES.

1. How many farthings in 2 pence? In 4 pence? In 6 pence? In 8 pence?

2. How many pence in 8 farthings? In 20 farthings? In 3 shillings? In 6 shillings?

3. How many shillings in 2 pounds? In 5 pounds? In 24 pence? In 60 pence?

WRITTEN EXERCISES.

1. How many farthings in 7 pence and 2 farthings?

OPERATION.

$$\begin{array}{rr} \text{d.} & \text{far.} \\ 7 & 2 \\ 4 & \\ \hline 28 & \\ 2 & \\ \hline 30 & \end{array}$$

SOLUTION.—In one penny there are 4 farthings, and in 7 pence there are 7 times 4 farthings, or 28 farthings; and 28 farthings plus 2 farthings, equal 30 farthings.

2. How many farthings in 15 d. and 3 far.?

3. How many pence in 13 s. and 8 d.?

4. How many pence in £8 14 s. and 10 d.?

5. How many shillings and pence in 567 pence?

OPERATION.

$$\begin{array}{r} 12)\underline{567} \\ 47\text{-}3\ \text{d.} \end{array}$$

SOLUTION.—There are 12 pence in one shilling, and in 567 pence there are as many shillings as 12 is contained times in 567, which are 47 shillings, and 3 pence remaining.

6. How many shillings and pence in 385 pence?

7. How many pence and farthings in 1075 farthings?

8. How many pounds and shillings in 1785 shillings?

9. How many pounds, shillings and pence in 1150 d.?

NOTES.—The money of Canada is the same as that of the United States. The unit of German money is the *mark* (Reichsmark), and is worth about $23\frac{4}{5}$ cents. The unit of French money is the *franc*, worth $19\frac{3}{10}$ cents.

◆

LESSON II.

Measures of Weight.

MEASURES OF WEIGHT are used to find how heavy a body is. There are three kinds: *Troy Weight*, *Avoirdupois Weight*, and *Apothecaries' Weight*.

TROY WEIGHT.

2. TROY WEIGHT is used in weighing gold, silver, jewels, etc.

TABLE.

24 grains (*gr.*).	equal	1 pennyweight,	*pwt.*
20 pennyweights	"	1 ounce,	*oz.*
12 ounces	"	1 pound,	*lb.*

MENTAL EXERCISES.

1. How many grains in 2 pwt.? In 4 pwt.? In 3 pwt.? In 5 pwt.?

2. How many pwt. in 3 oz.? In 5 oz.? In 4 oz.? In 48 gr.? In 72 gr.?

3. How many ounces in 3 pounds? In 5 pounds? In 40 pwt.? In 60 pwt.?

4. How many pounds in 24 ounces? In 60 ounces? In 84 ounces? In 96 oz.?

WRITTEN EXERCISES.

1. How many grains in 8 pwt. and 12 gr.?

2. How many pennyweights in 17 oz. and 14 pwt.?

3. How many ounces in 16 lb. and 13 oz.?

4. How many pwt. and grains in 275 grains?

5. How many ounces and pwt. in 54 pwt.?

6. How many pwt. in 5 lb. 6 oz. and 10 pwt.?

AVOIRDUPOIS WEIGHT.

4. AVOIRDUPOIS WEIGHT is used in weighing everything except jewels and the precious metals.

TABLE.

16 ounces	equal	1 pound,	*lb.*
100 pounds	"	1 hundredweight,	*cwt.*
20 hundredweight	"	1 ton,	*T.*

NOTE.—A *quarter* means one-fourth of a hundredweight.

MENTAL EXERCISES.

1. How many ounces in 3 pounds? In 5 lb.? In 7 lb.?

2. How many pounds in a quarter of flour? How many pounds in "half a hundred" of salt?

3. How many pounds in 32 ounces? In 80 ounces?

4. How many hundredweight in 4 T.? In 6 T.? In 300 lb.?

WRITTEN EXERCISES.

1. How many ounces in 10 lb. 15 oz.?

2. How many pounds in 16 cwt. 75 lb.?

3. How many hundredweight in 9 T. 17 cwt.?

4. How many pounds and hundredweight in 724 lb.?

5. How many lb., oz. and cwt. in 1703 oz.?

APOTHECARIES' WEIGHT.

3. APOTHECARIES' WEIGHT is used in prescribing and mixing dry medicines.

TABLE.

20 grains (*gr.*)	equal	1 scruple,	℈.
3 scruples	"	1 dram,	ʒ.
8 drams	"	1 ounce,	℥.
12 ounces	"	1 pound,	℔.

MENTAL EXERCISES.

1. How many gr. in 3 scruples? In 5 scruples? In 1 dram? In 2 drams?

2. How many scruples in 4 drams? In 7 drams? In 40 grains? In 80 grains?

3. How many drams in 5 ounces? In 12 ounces? In 12 scruples? In 36 scruples?

4. How many ounces in 3 pounds? In 7 pounds? In 40 drams? In 88 drams?

5. How many pounds in 36 ounces? In 60 ounces? In 96 drams?

WRITTEN EXERCISES.

1. How many grains in 7℈ and 18 gr.?

2. How many scruples in 15ʒ 1℈?

3. How many ounces in 16 ℔ 11 ℥?

4. How many scruples and grains in 277 gr.?

5. How many drams and ounces in 310ʒ?

6. How many pounds, ounces and drams in 300℈?

LESSON III.

Measures of Extension.

MEASURES OF EXTENSION are used to find the *length*, *surface*, and *volume* of bodies.

2. Measures of Extension are of three kinds: *Long Measure*, *Surface Measure*, and *Cubic Measure*.

LONG MEASURE.

3. Long Measure is used for the general purpose of measuring length and distances.

TABLE.

12 inches (*in.*) . . .	equal	1 foot, . .	*ft.*
3 feet	"	1 yard, . .	*yd.*
5½ yards, or 16½ feet, .	"	1 rod, . .	*rd.*
320 rods	"	1 mile, . .	*mi.*

Note.—In measuring *land* and *roads* we use a *chain*, 4 rods long, divided into 100 *links*. In measuring goods sold by the *yard*, we divide the yard into *halves*, *quarters*, *eighths*, etc.

MENTAL EXERCISES.

1. How many inches in 3 feet? In 5 feet? In 8 feet? In 2 yards?

2. How many feet in 4 yards? In 12 yards? In 2 rods? In 48 inches?

3. How many yards in 2 rods? In 4 rods? In 7 rods? In 36 feet?

4. Draw an inch on the board; draw a foot; draw a yard. Mark off in the school-room the length of a rod.

WRITTEN EXERCISES.

1. How many inches in 9 ft. 6 in.?

2. How many feet in 4 rd. 5 yd.?

3. How many yards in 2 miles and 120 rods?

4. How many feet and inches in 125 in.?

5. How many yards in 72 in.? In 156 in.?

6. How many miles and rods in 644 rd.?

SURFACE MEASURE.

4. Surface or Square Measure is used in measuring *surfaces;* as land, boards, papering, plastering, etc.

TABLE.

144 square inches (*sq. in.*)	equal	1 square foot, .	*sq. ft.*
9 square feet . . .	"	1 square yard, .	*sq. yd.*
30¼ square yards . . .	"	1 perch or sq. rod,	*P.*
160 perches	"	1 acre, ...	*A.*
640 acres	"	1 square mile, .	*sq. mi.*

NOTE.—In measuring the area of land, we have 10,000 square links = 1 square chain, 10 square chains = 1 acre, 640 acres = 1 square mile.

MENTAL EXERCISES.

1. Mark off a square inch on the blackboard.

2. Mark off a square foot on the blackboard.

3. Mark off a square yard on the blackboard. Divide it into square feet.

4. How many feet in the length of each side of a square yard? Show how many square feet in a square yard.

5. Divide a square foot into square inches. How many square inches in a square foot?

WRITTEN EXERCISES.

1. How many square inches in 5 square feet?

2. How many square feet in 12 square yards?

3. How many square yards in 8 square rods?

4. In 108 square feet how many square yards?

5. How many square feet in 1728 square inches?

6. How many acres in 960 square rods?

CUBIC MEASURE.

5. CUBIC OR SOLID MEASURE is used in measuring things which have length, breadth, and thickness.

TABLE.

1728 cubic inches (*cu. in.*)	equal	1 cubic foot,	*cu. ft.*
27 cubic feet	"	1 cubic yard,	*cu. yd.*
16 cubic feet	"	1 cord foot,	*c. ft.*
8 cord feet, or 128 cubic feet	"	1 cord of wood,	*cd.*

NOTE.—Let the teacher take special pains in explaining this table to the pupils. Show them a cubic inch; draw a cubic foot and a cubic yard on the board. Make a miniature cord of wood out of little sticks, etc. Show also how the contents equal the products of the three dimensions.

1. How many cubic feet in 8 cu. yd.? Cubic yards in 540 cu. ft.?

2. How many cubic feet in 6 cords? How many cord feet in 12 cords?

LESSON IV.

Measures of Capacity.

MEASURES OF CAPACITY are used to find the quantity of fluids and many dry substances.

2. Measures of Capacity are of two kinds: *Liquid Measure* and *Dry Measure.*

LIQUID MEASURE.

3. LIQUID MEASURE is used in measuring nearly all kinds of liquids.

TABLE.

4 gills (*gi.*)	equal	1 pint,	marked	*pt.*
2 pints	"	1 quart,	"	*qt.*
4 quarts	"	1 gallon,	"	*gal.*

NOTE.—Give the pupils definite ideas of the *gill, pint* and *quart.* Have them judge of the capacity of cups, tumblers, etc.

MENTAL EXERCISES.

1. How many gills in 6 pints? In 8 pints? In 3 quarts? In 1 gallon?

2. How many pints in 12 quarts? In 2 gallons? In 44 gills? In 3 gallons?

3. How many quarts in 6 gallons? In 10 gallons? In 20 pints? In 40 gills?

4. How much will a quart of milk cost at 6 cents a pint?

WRITTEN EXERCISES.

1. How many pints in 17 qt. 1 pt.?

2. How many quarts in 33 gal. 3 qt.?

3. How many gallons in 21 hhd. 20 gal.?

4. How many gal. in 120 qt.? In 160 pt.?

DRY MEASURE.

4. DRY MEASURE is used in measuring dry substances, as grain, fruit, salt, coal, etc.

TABLE.

2 pints (*pt.*)	equal	1 quart,	marked	*qt.*
8 quarts	"	1 peck,	"	*pk.*
4 pecks	"	1 bushel,	"	*bu.*

MENTAL EXERCISES.

1. How many pints in 5 quarts? In 9 quarts? In 1 peck? In 1 bushel?

2. How many quarts in 3 pecks? In 7 pecks? In 3 bushels? In 24 pints?

3. How many pecks in 5 bushels? In 10 bushels? In 24 quarts? In 80 pints?

4. How many bushels in 12 pecks? In 32 quarts? In 64 pints? In 64 quarts?

5. How many pints in a peck? How many pints in a bushel? How many quarts in a bushel?

WRITTEN EXERCISES.

1. How many pints in 17 qt. 1 pt.?

2. How many quarts in 1 bu. 3 pk. 5 qt.?

3. How many pecks in 55 quarts?

4. How many bushels in 128 pints?

LESSON V.

MEASURES OF TIME AND CIRCLES.

Measures of Time.

TIME MEASURE is used for measuring time or duration.

TABLE.

60 seconds (*sec.*) . . .	equal	1 minute, . . .	*m.*
60 minutes	“	1 hour, ...	*h.*
24 hours	“	1 day, ...	*da.*
7 days	“	1 week, ...	*wk.*
365 days, or 12 months	“	1 common year, .	*yr.*
100 years	“	1 century, . . .	*C.*

WRITTEN EXERCISES.

1. How many seconds in 2 minutes? In 3 minutes? In 4 minutes?

2. How many minutes in 2 hours? In 3 hours? In 4 hours?

3. How many hours in 2 days? In 3 days? In 4 days?

4. How many days in 5 wk. 3 da.? In 6 wk. 5 da.? In 3 common years?

5. How many days in 144 hours? In 216 hours? How many days and hours in 300 hours?

The year is divided into 4 seasons—*spring*, *summer*, *autumn*, and *winter*—each consisting of three months. From the following table the pupil may learn the name of each month, the number of days in each, and the months belonging to each season. Every fourth year is called *leap* year.

	No. of Month.	Names.	Days.
Spring.	3d month,	March,	31.
	4th month,	April,	30.
	5th month,	May,	31.
Summer.	6th month,	June,	30.
	7th month,	July,	31.
	8th month,	August,	31.
Autumn.	9th month,	September,	30.
	10th month,	October,	31.
	11th month,	November,	30.
Winter.	12th month,	December,	31.
	1st month,	January,	31.
	2d month,	February,	28, in leap year 29.

The number of days in each month may be easily remembered by means of the following stanza:

> Thirty days hath September,
> April, June, and November;
> All the rest have thirty-one,
> Excepting February alone,
> To which we twenty-eight assign,
> Till leap year gives it twenty-nine.

CIRCULAR MEASURE.

2. Circular Measure is used to measure arcs of circles, angles, etc.

TABLE.

60 seconds (″)	equal	1 minute,	′
60 minutes	"	1 degree,	°
30 degrees	"	1 sign,	*S.*
12 signs, or 360 degrees	"	1 circle,	*C.*

WRITTEN EXERCISES.

1. How many seconds in 4 minutes? In 5′? In 24′? In 8′ 36″?

2. How many minutes in 240 seconds? How many minutes and seconds in 500 seconds?

3. How many minutes in 5 degrees? In 5° 24′? In 16° 36′?

4. How many degrees in 360 minutes? How many degrees and minutes in 650 minutes?

MISCELLANEOUS TABLES.

COUNTING.

12 things = 1 dozen.
12 dozen = 1 gross.
12 gross = 1 great gross.
20 things = 1 score.

TABLE OF PAPER.

24 sheets = 1 quire.
20 quires = 1 ream.
480 sheets = 1 ream.

SIZES OF BOOKS.

A sheet folded in 2 leaves makes a *folio* size.
A sheet folded in 4 leaves " a *quarto*, or *4to*, size.
A sheet folded in 8 leaves " an *octavo*, or *8vo*, size.
A sheet folded in 12 leaves " a { *duodecimo*, or *12mo*, size.
A sheet folded in 18 leaves " an *18mo* size.
A sheet folded in 24 leaves " a *24mo* size.

MENTAL EXERCISES.

1. How many things in 5 dozen? In 6 dozen? How many dozen in 2 gross? In 5 gross?

2. How many dozen in 60 things? In 72 things? How many gross in 48 dozen? In 97 dozen?

3. How many years in 3 score? Years in "3 score and 10"? Dozen in a great gross?

WRITTEN EXERCISES.

1. How many pencils in a gross? Pens in a great gross?

2. How many sheets in 4 quires? In 3 quires and 10 sheets? Quires in 120 sheets? In 4½ reams?

3. How many sheets in 4 reams? Quires in 6½ reams? Sheets in 3 reams and 4 quires?

THE ROMAN NOTATION.

THE Roman Method of notation employs seven capital letters to represent numbers.

LETTERS:	I,	V,	X,	L,	C,	D,	M.
VALUES:	1,	5,	10,	50,	100,	500,	1000.

2. Repeating a letter repeats its value.

Thus, II represents 2; XX, 20; CCC, 300, etc.

3. When a letter is placed *after* one of greater value, the *sum* of their values is the number represented.

Thus, VI represents 6; XV, 15; LX, 60; CXX, 120.

4. When a letter is placed *before* one of greater value, the *difference* of their values is the number represented.

Thus, IV represents 4; IX, 9; XL, 40; XC, 90.

TABLE OF ROMAN NOTATION.

I	One.	XXX	Thirty.
II	Two.	XL	Forty.
III	Three.	L	Fifty.
IV	Four.	LX	Sixty.
V	Five.	LXX	Seventy.
VI	Six.	XC	Ninety.
VII	Seven.	C	One hundred.
VIII	Eight.	CC	Two hundred.
IX	Nine.	D	Five hundred.
X	Ten.	DC	Six hundred.
XI	Eleven.	DCCCC	Nine hundred.
XIV	Fourteen.	M	One thousand.
XV	Fifteen.	MM	Two thousand.
XIX	Nineteen.	MCLX	1160.
XX	Twenty.	MDCCCXCIII,	1893.

EXERCISES.

Read the following numbers:

1. XLI. **2.** XXIV. **3.** LVII. **4.** XCIX. **5.** CXXIV. **6.** CCLV. **7.** MDXCVI.

Express the following numbers by the Roman method:

1. Sixteen. **2.** Twenty-seven. **3.** Forty-nine. **4.** Sixty-eight. **5.** Eighty-four. **6.** Two hundred and forty-five

MULTIPLICATION TABLE.

Once			**2 times**			**3 times**			**4 times**		
1	is	1	1	are	2	1	are	3	1	are	4
2	"	2	2	"	4	2	"	6	2	"	8
3	"	3	3	"	6	3	"	9	3	"	12
4	"	4	4	"	8	4	"	12	4	"	16
5	"	5	5	"	10	5	"	15	5	"	20
6	"	6	6	"	12	6	"	18	6	"	24
7	"	7	7	"	14	7	"	21	7	"	28
8	"	8	8	"	16	8	"	24	8	"	32
9	"	9	9	"	18	9	"	27	9	"	36
10	"	10	10	"	20	10	"	30	10	"	40
11	"	11	11	"	22	11	"	33	11	"	44
12	"	12	12	"	24	12	"	36	12	"	48

5 times			**6 times**			**7 times**			**8 times**		
1	are	5	1	are	6	1	are	7	1	are	8
2	"	10	2	"	12	2	"	14	2	"	16
3	"	15	3	"	18	3	"	21	3	"	24
4	"	20	4	"	24	4	"	28	4	"	32
5	"	25	5	"	30	5	"	35	5	"	40
6	"	30	6	"	36	6	"	42	6	"	48
7	"	35	7	"	42	7	"	49	7	"	56
8	"	40	8	"	48	8	"	56	8	"	64
9	"	45	9	"	54	9	"	63	9	"	72
10	"	50	10	"	60	10	"	70	10	"	80
11	"	55	11	"	66	11	"	77	11	"	88
12	"	60	12	"	72	12	"	84	12	"	96

9 times			**10 times**			**11 times**			**12 times**		
1	are	9	1	are	10	1	are	11	1	are	12
2	"	18	2	"	20	2	"	22	2	"	24
3	"	27	3	"	30	3	"	33	3	"	36
4	"	36	4	"	40	4	"	44	4	"	48
5	"	45	5	"	50	5	"	55	5	"	60
6	"	54	6	"	60	6	"	66	6	"	72
7	"	63	7	"	70	7	"	77	7	"	84
8	"	72	8	"	80	8	"	88	8	"	96
9	"	81	9	"	90	9	"	99	9	"	108
10	"	90	10	"	100	10	"	110	10	"	120
11	"	99	11	"	110	11	"	121	11	"	132
12	"	108	12	"	120	12	"	132	12	"	144

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